CSIPW-93B-F0006

國外公差報告

中山科學研究院

國外公差心得報告

批示					
公差年度	93	所屬單位各級主管	計品會	政戰部	企劃處
單位	二所工程發展組 二所技術推廣組				
級職	荐聘技正 簡聘技正				
姓名	黃石柱 游欽宏				

國外公差人員返國報告主官（管）審查意見表

本院二所游欽宏博士與黃石柱先生等二員赴德國公差，出國公差報告在規定時程內完成，內容豐富翔實，極具參考價值，對半導體與光電產業製程設備研發計畫之執行及後續建案相當有助益，此次赴德國公差甚有成效。

游欽宏博士等二員赴德國公差，在短時間內除了參觀在慕尼黑舉辦之歐洲半導體設備及材料大展(SEMICON Europa 2004)以及在漢諾威舉辦之全球工廠自動化展(FACTORY AUTOMATION)，並參訪德國雷射應用研究中心 LZH 公司。本次公差中，深入瞭解歐洲地區半導體製程設備產業及全球工廠自動化的最新發展趨勢，有助於本院二所在科專計畫釐定研發方向。

本次公差透過實地參訪及技術研討，已初步掌握水導引雷射切割技術，以及利用多重雷射光束吸收原理作玻璃切割等先進技術之發展及訊息，並掌握全球最新雷射應用發展趨勢並洽談可能之國際合作，對未來在雷射應用機台之研發規劃及建案上，可提供發展方向與規格訂定之參考。

依本院 85.11.25（85）蓮菁字 15378 號令，返國報告上呈時應附主官評審意見

<table>
<tr><td colspan="4">報　告　資　料　頁</td></tr>
<tr><td>1.報告編號：
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考察</td><td>3.完成日期：
93 年 6 月 18 日</td><td>4.總頁數：39</td></tr>
<tr><td colspan="4">5.報告名稱：赴德國參訪歐洲國際半導體設備、工廠自動化展及雷射應用技術出國公差報告</td></tr>
<tr><td rowspan="2">6.核准文號</td><td>人令文號</td><td colspan="2" rowspan="2">睦晥字第 0930006821 號</td></tr>
<tr><td>部令文號</td></tr>
<tr><td colspan="2">7.經費</td><td colspan="2">新台幣：壹拾捌萬陸仟貳佰捌拾參元整</td></tr>
<tr><td colspan="2">8.出(返)國日期</td><td colspan="2">93.4.19 至 93.4.26</td></tr>
<tr><td colspan="2">9.公差地點</td><td colspan="2">德國</td></tr>
<tr><td colspan="2">10.公差機構</td><td colspan="2">慕尼黑歐洲國際半導體設備及材料展
漢諾威工廠自動化展
德國雷射應用研發中心 LZH 公司</td></tr>
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行政院及所屬各機關出國報告
（出國類別：考察）

（裝 釘）

赴德國參訪歐洲國際半導體設備、工廠自動化展及雷射應用技術出國公差報告

服務機關：中山科學研究院
出 國 人 職 稱：簡聘技正
荐聘技正
姓　　名：游欽宏
黃石柱

出國地區：德國
出國期間：93.4.19～93.4.26
報告日期：93.6.18

附件二

系統識別號

行政院及所屬各機關出國報告提要

出國報告名稱：赴德國參訪歐洲國際半導體設備、工廠自動化展及雷射應用技術出國公差報告

頁數 39 含附件：☑是 □ 否

出國計畫主辦機關/聯絡人/電話：
國防部軍備局中山科學研究院/黃石柱/(03)4712201 轉 356727
出國人員姓名/服務機關/單位/職稱/電話：
游欽宏/二所技術推廣組/簡聘技正/352302
黃石柱/二所工程發展組/荐聘技正/356727
出國類別：☑1 考察□2 進修□3 研究□4 實習□5 其他

出國期間：93.4.19～93.4.26
出國地區：德國
報告日期：93.6.18
分類號/目

關鍵詞：電漿輔助化學氣相沉積(PECVD)、蝕刻(Etching)、水導引雷射(Laser-Microjet)、多重雷射光束吸收(MLBA)

內容摘要：(二百至三百字)
本報告之重點為參訪在慕尼黑舉辦歐洲國際半導體設備及材料大展(SEMICON Europa 2004)，並實地參訪德國著名之漢諾威雷射應用研究中心 LZH e.V.（LASER ZENTRUM HANNOVER e.V.）公司及參觀在漢諾威舉辦的工廠自動化展(FACTORY AUTOMATION)，透過實地參訪及技術研討，掌握全球最新半導體製程設備及組件之技術及市場發展趨勢並洽談可能之國際合作，對未來規劃之建案計畫，能提供具前瞻性發展之方向與規格訂定之參考，以有效執行現有計畫並據以推動後續建案工作，對本院未來軍通科技專案之規劃與執行，甚有助益。

本文電子檔已上傳至出國報告資訊網（http://report.gsn.gov.tw）

附件三

行政院及所屬各機關出國報告審核表

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<tr><td colspan="2">出國計畫主辦機關名稱：國防部軍備局中山科學研究院</td></tr>
<tr><td colspan="2">出國人姓名/職稱/服務單位：游欽宏、黃石柱/技正/中山科學研究院等 2 人</td></tr>
<tr><td>出國計畫主辦機關審核意見</td><td>□1.依限繳交出國報告
□2.格式完整
□3.內容充實完備
□4.建議具參考價值
□5.送本機關參考或研辦
□6.送上級機關參考
□7.退回補正，原因：□①不符原核定出國計畫　□②以外文撰寫或僅以所蒐集外文資料為內容　□③內容空洞簡略　□④未依行政院所屬各機關出國報告規格辦理　□⑤未於資訊網登錄提要資料及傳送出國報告電子檔
□8.其他處理意見：</td></tr>
<tr><td>層轉機關審核意見</td><td>□同意主辦機關審核意見　□全部　□部分
（填寫審核意見編號）
□退回補正，原因：　　　　　（填寫審核意見編號）
□其他處理意見：</td></tr>
</table>

說明：

一、出國計畫主辦機關即層轉機關時，不需填寫「層轉機關審核意見」。

二、各機關可依需要自行增列審核項目內容，出國報告審核完畢本表請自行保存。

三、審核作業應於出國報告提出後二個月內完成。

中山科學研究院公差出國人員報告目錄

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一、SEMI 協會展示期間研擬及修訂國際標準的相關資料

(1).Test,Assembly and Packaging Technical Committee meeting－－－ A1-A4
(2).MEMS Technical Committee meeting－－－－－－－－－－－－－－－ A5-A8
(3).Equipment Automation Technical Committee meeting－－－－－－－ A9-A13
(4).Micro patterning Technical Committee meeting－－－－－－－－ A14-A16
(5).Silicon Wafer Technical Committee meeting－－－－－－－－－ A17-A22
(6).Compound Semiconductor Materials Technical Committee meeting－－－－－－－－－－－－－－－－－－－－－－－－－－－－－－－－－－ A23-A25
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二、各廠商在 e-Manufacturing 和 e-Diagnostics 二項領域簡報資料

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(2).e-Diagnostics/e-Manufacturing requirements and successes at AMD

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壹、出國目的及緣由

半導體產業及平面顯示器產業，即是行政院提出兩兆雙星願景之中的「兩兆」產業，每年該二項產業所投資之設備絕大部份是國外製造，發展半導體製程設備及平面顯示器製程設備的自製能力為我國科技產業的重要項目，經濟部結合產、官、學投入研發，本院近年來執行經濟部科專計畫之研發工作，甚受經濟部及產業界肯定，如何掌握產業市場及技術趨勢，以利後續發展，是經濟部技術處相當重視之一。

配合本院執行經濟部「新興產業精密機械系統」科技專案之半導體與光電產業製程設備及關鍵組件研發計畫工作需求，赴德國慕尼黑，參加歐洲國際半導體設備及材料大展 （SEMICON Europa 2004)，並實地參訪著名之德國漢諾威雷射應用研究中心 LZH e.V. (LASER ZENTRUM HANNOVER e.V.） 公司及參觀工廠自動化展(FACTORY AUTOMATION)，透過實地參訪及技術研討，掌握全球最新半導體製程設備及組件之技術及市場發展趨勢並洽談可能之國際合作，對未來規劃之建案計畫，能提供具前瞻性發展之方向與規格訂定之參考，以有效執行現有計畫並據以推動後續建案工作。

貳、公差心得

本次公差任務主要分為三大部份，分別參觀位於德國慕尼黑的歐洲國際半導體設備及材料大展（SEMICON Europa 2004)、參訪著名之德國雷射應用研究中心 LZH e.V. (LASER ZENTRUM HANNOVER e.V.）公司及參觀漢諾威商品展(Hannover MESSE)的工廠自動化展(FACTORY AUTOMATION)，本心得報告即按此順序就參觀參訪分別說明。

一. 德國慕尼黑的歐洲國際半導體設備及材料大展（SEMICON Europa 2004）

(一).SEMI 公司及 SEMICOM Europa 2004

SEMICON Europa 2004 展系由 SEMI 公司主辦，展示期間為 4 月 20 至 4 月 22 日，在德國慕尼黑展出為期三天，完全針對半導體加工製程、材料和微機電系統 MEMS(Micro Electro Mechanical System)及平面顯示器 FPD（Flat Panel Display）等所需要的設備展示，共有 700 多家該領域的先進設備廠商參展。

SEMI 公司是一個國際性半導體產業貿易協會，其會員主要來自全球各半導體、顯示器製造設備及材料供應公司及專業個人所組成，歐洲地區有 250 家為其會員佔整個協會的 12%，今年是在慕尼黑主辦的第六年，提供半導體設備、材料、技術服務和相關工業的輸出；近年來 SEMICON Europa 已進入歐洲工業新階段，朝向微機電系統 MEMS(Micro Electro Mechanical System)及平面顯示器 FPD（Flat Panel Display）的領域發展，歐洲為全球在相關領域技術發展上較為先進的一個區域。

另外，SEMI 致力於國際工業標準計畫已有二十多年歷史，其計設有北美、歐洲及日本等三個區域的工業標準制訂委員會。在各區域委員會下設有設備、材料、封裝、微

影、設施、安全、及平面顯示器等六個分組進行各種標準之研擬及修訂。近年來台灣在半導體及顯示器製造上已在全球佔有相當重要地位，近年已透過台灣半導體產業協會，積極參加相關製程設備及材料之標準制訂，期能早期掌握規格發展方向。本院二所為台灣半導體產業協會之一團體會員，配合半導體與光電產業製程設備計畫之執行，也投入在全球製程設備標準之制訂上，以掌握市場及技術之發展。

在會場有針對半導體、平面顯器和相關工業教育和技術影片播放，本次參觀共計看三片分別：

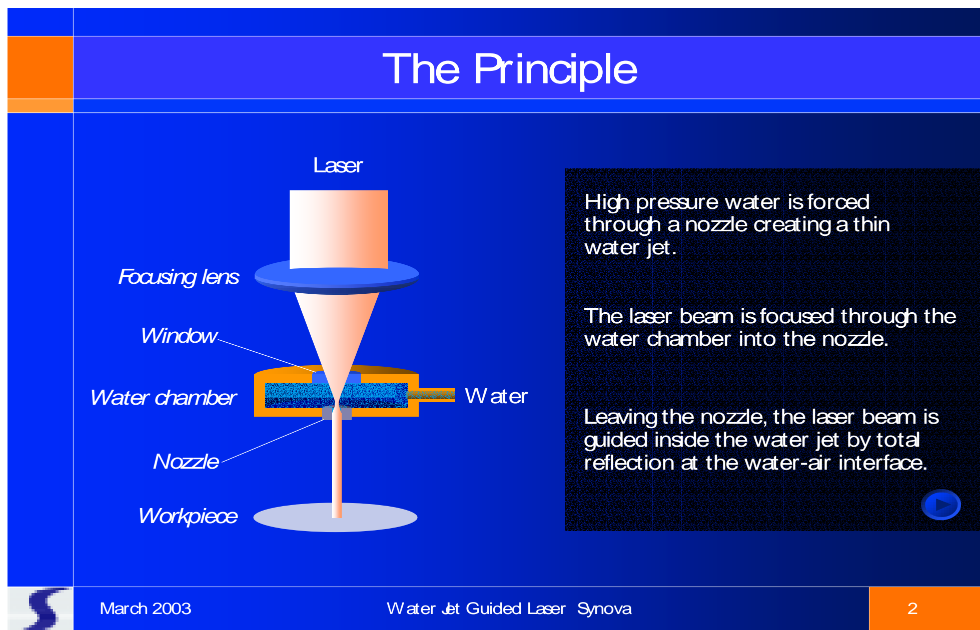
1. Etch 蝕刻—該影片介紹非導體、半導體與導體材料如何被雕刻在近代電子微晶片裡的蝕刻製程。
2. Implantation 植入技術—該影片介紹對離子植入製程和說明 Silicon 矽基如何改變電子特性。
3. Lithography 微影—該影片介紹微影術在半導體製造之製程。

該公司所策劃之錄影帶，深入淺出的說明，對新進人員的教育有很快瞭解該項技術重點，在本院若有新加入科專技術研發人員，可利用適當時機觀看。

(二). 水導引雷射切割 (Laser Microjet, LMJ)

在會場得到 Synova 公司一份”The Water Jet Guided laser and its Applications in Chip Manufacturing” 係利用水噴射導引雷射在晶圓製造上的應用，該公司簡稱為 LMJ (Laser Microjet)，主要原理雷射光經聚焦經過水腔室(chamber)，高壓水經過噴嘴，形成水柱，雷射光穿過水腔室，進入噴嘴，離開噴嘴時，雷射光被導引進入水柱裡，介由水和空氣之間在水柱中作反射，直到加工工

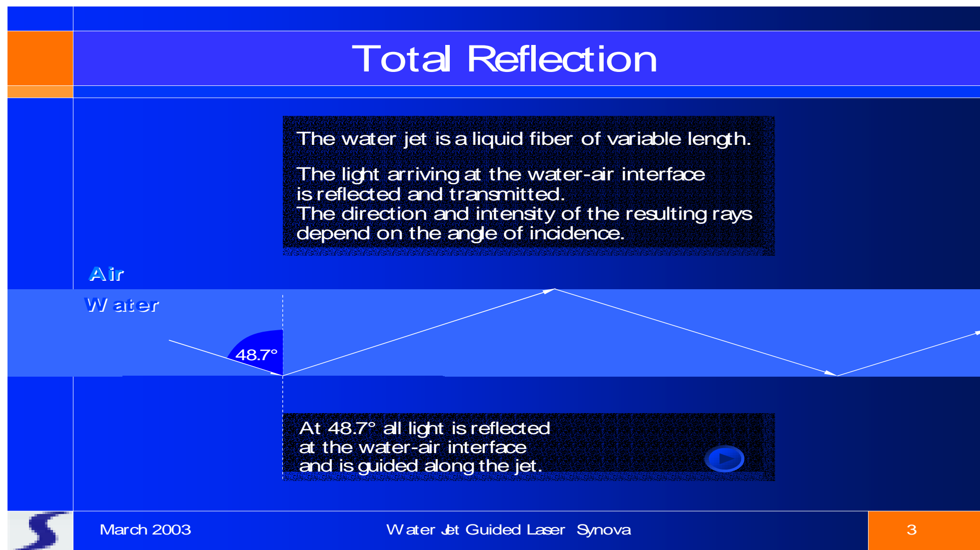
件，如圖一 LMJ 原理及基本架構。



圖一.LMJ 原理及基本架構

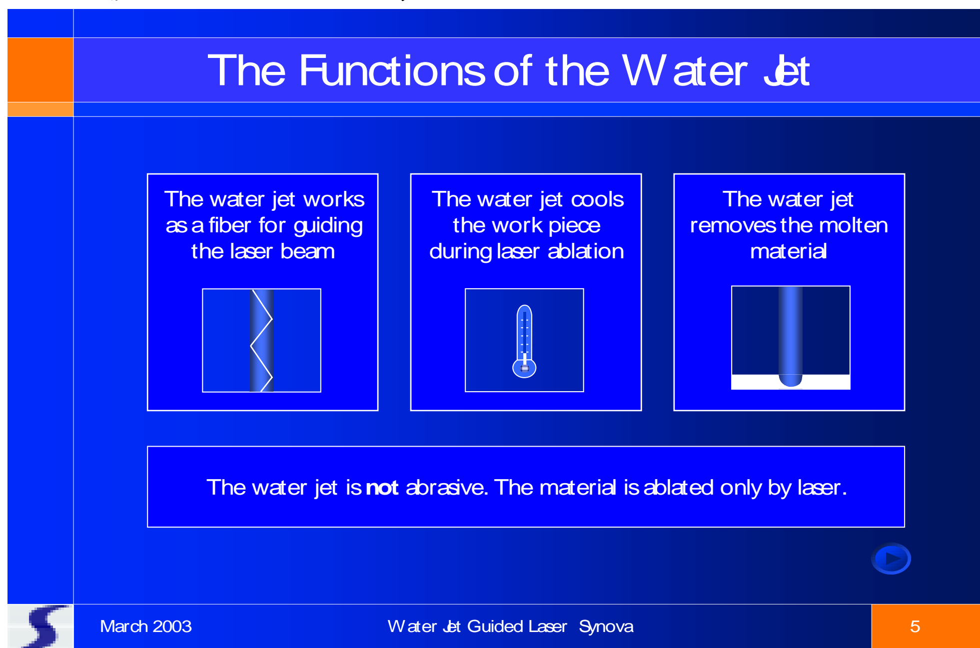
圖二說明雷射光在水及空氣中間之折射關係，熔解過程如下：

1. 水柱直接到工件
2. 雷射波被導引到工件表面
3. 金屬材料吸收雷射波
4. 雷射能量轉變成 plasma
5. 金屬吸收雷射光而熔解或熔化
6. 在雷射光的端點 plasma 就消失，僅有水柱與工件表面接觸
7. 水柱驅逐熔化的金屬
8. 當下一個雷射波放射時，水柱移除金屬被雷射熔化的任何熱如此迴環達到切割功能，而不產生熱傷害



圖二. 雷射光在水及空氣中間之折射關係

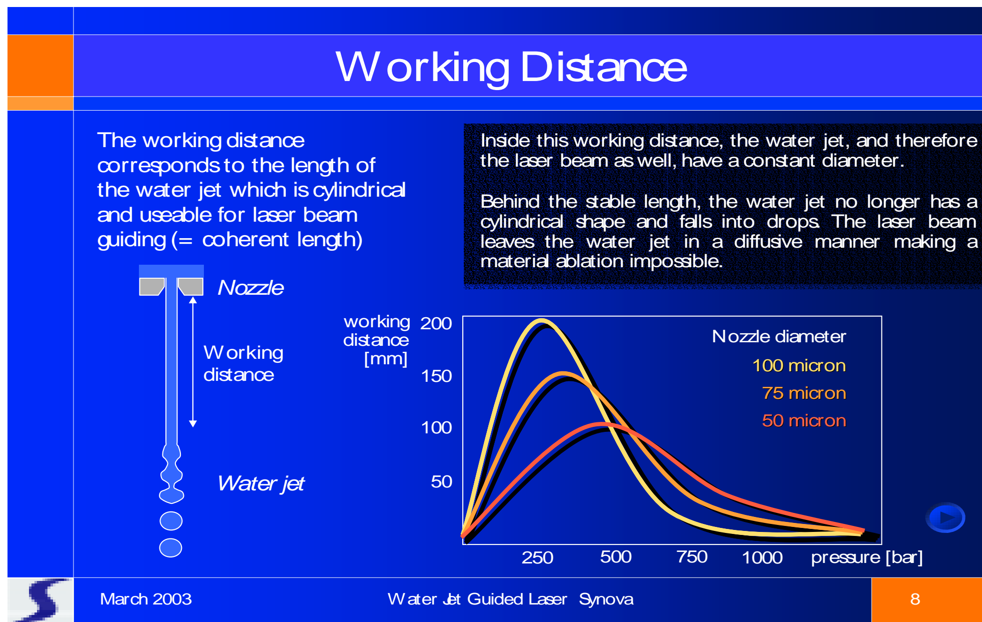
圖三說明水柱的主要功能，左圖說明水柱像是光纖導引雷射光，中間圖說明當雷射熔化時水柱冷卻工件，右圖說明水柱移除熔化的金屬。



圖三. 水柱的主要功能

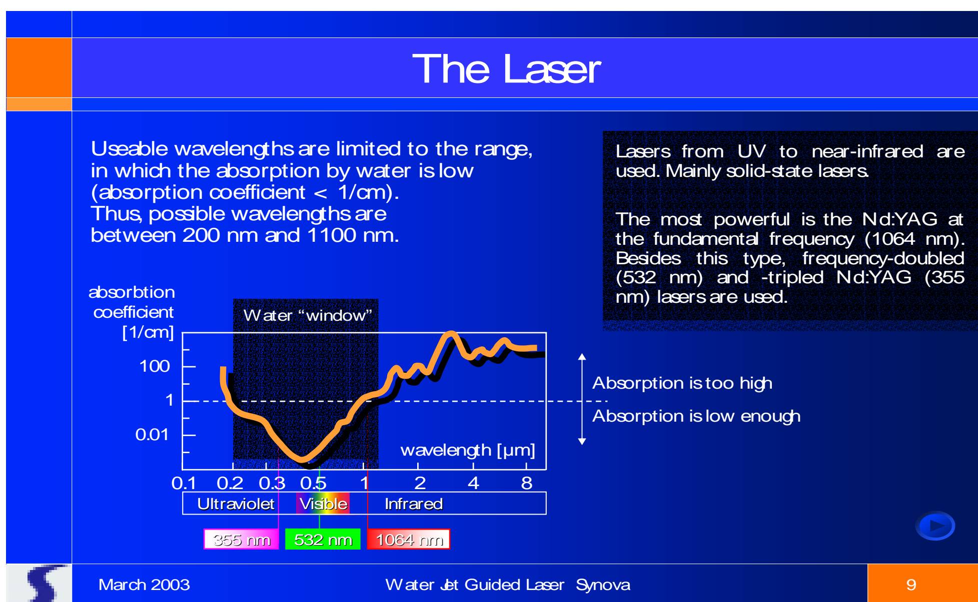
圖四說明分別用三種噴嘴直徑對水壓與工作距離關係，顯示其工作距離很長，對調整聚焦很方便，傳統雷射切割對雷射聚焦影響在工件的穿透性，且聚焦範圍最小，調整不

易。

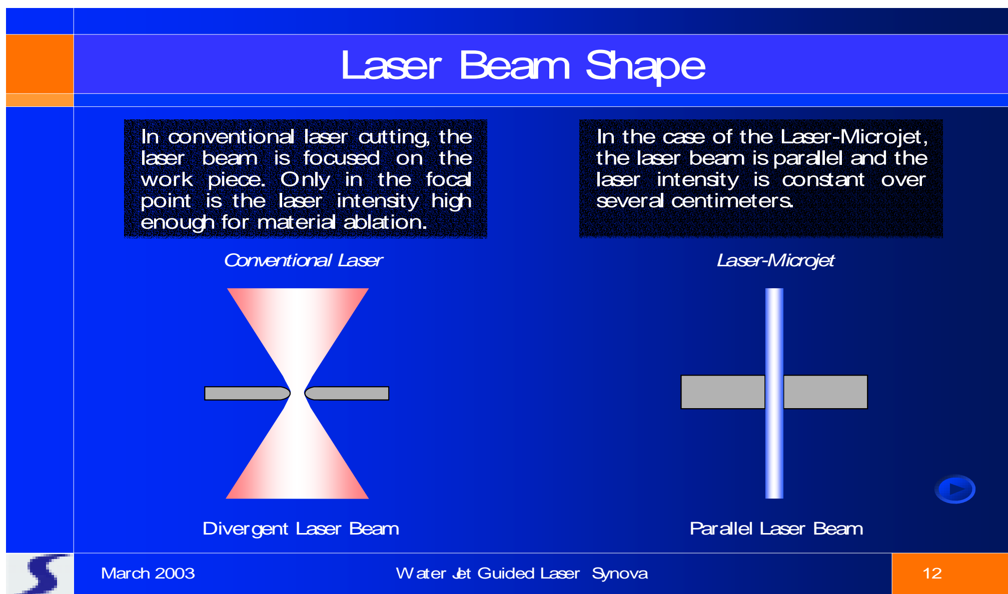


圖四.三種噴嘴直徑對水壓與工作距離關係

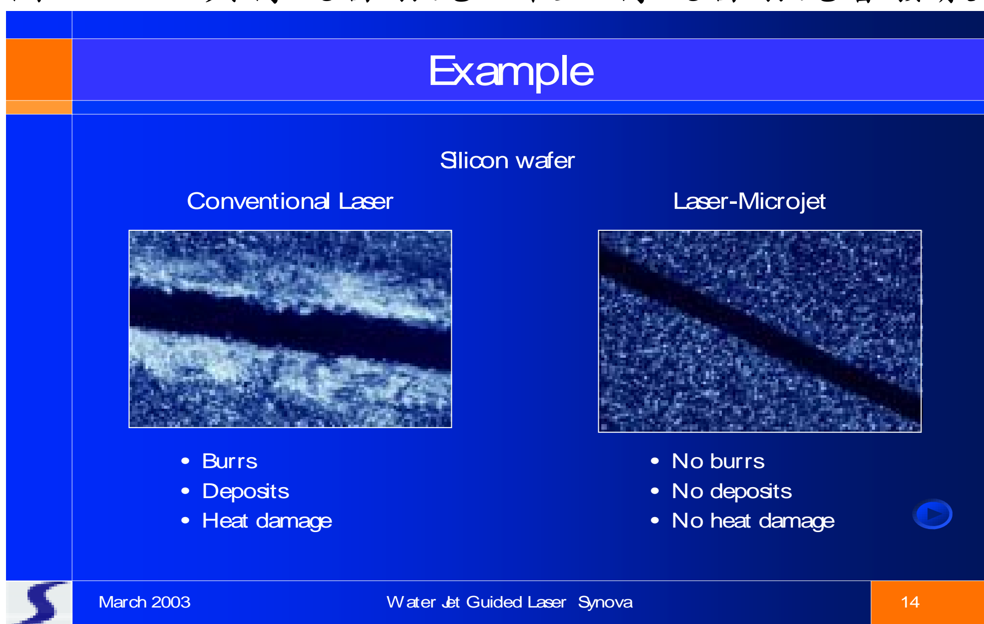
圖五說明雷射波長介於 200nm-1100nm 才可利用，圖六說明利用 LMJ 與傳統雷射光比較，傳統雷射光會發散，圖七比較傳統雷射切割及 LMJ 切割的比較，傳統雷射加工會有毛邊、沈澱物、熱傷害等缺點，而 LMJ 方法具有 1.沒有毛邊 2.沒有沈澱物 3.沒有熱傷害等優點。



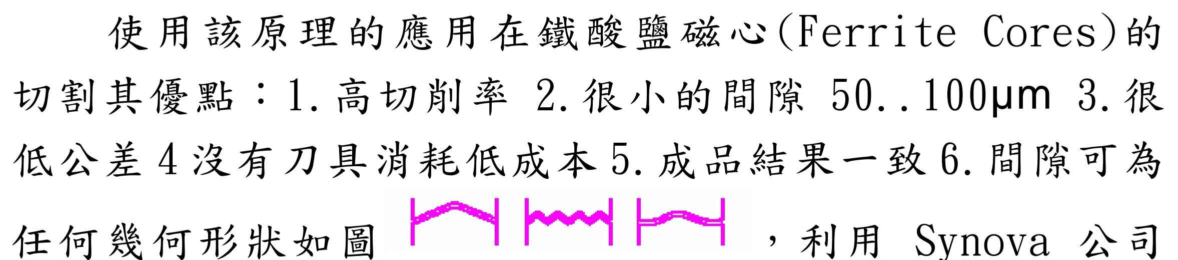
圖五.雷射波長介於 200nm-1100nm 才可利用 LMJ 方法



圖六.LMJ 與傳統雷射光比較，傳統雷射光會發散



圖七.傳統雷射切割及 LMJ 切割的比較

使用該原理的應用在鐵酸鹽磁心(Ferrite Cores)的切割其優點：1.高切削率 2.很小的間隙 50..100μm 3.很低公差 4 沒有刀具消耗低成本 5.成品結果一致 6.間隙可為任何幾何形狀如圖  ，利用 Synova 公司

LCS300 機型，切割出來各種形狀如圖八。

Ferrite Cores

圖八.各式鐵酸鹽磁心

使用該原理的應用在薄晶圓片的切割，其優點：

1.很一致的切割品質

2.沒有機械應力

3.沒有碎片

4.高強度

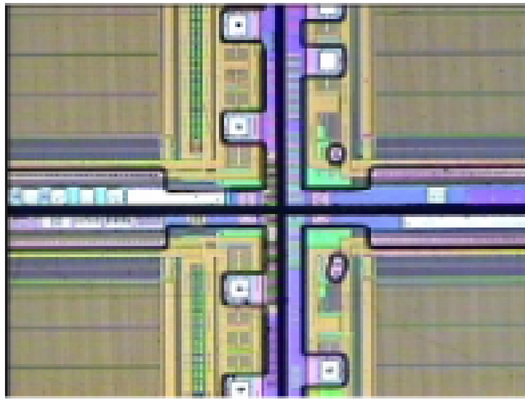
5.任何方向可切割

6.可鑽孔,劃線,銑槽,邊角研磨,作 mark

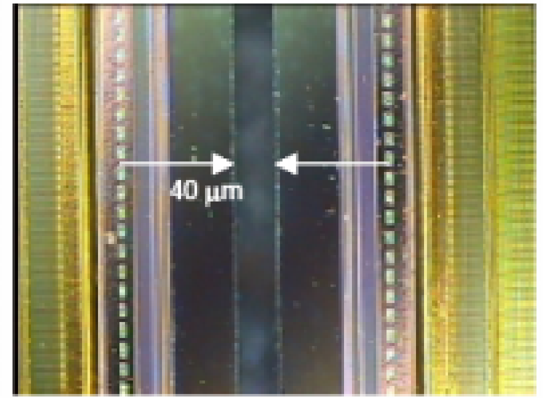
7.切割寬度 25-80 micron

8.對 50micron 厚的晶圓切割速度可達 200 mm/s

利用 Synova 公司 LDS200 機型切割晶圓，由圖九可看出切割品質



A perfect cut of the dies



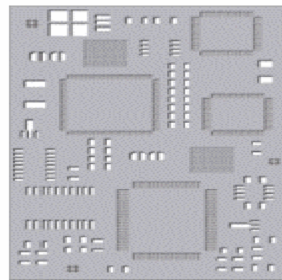
Magnified view of the diced street

圖九. 晶圓使用 LMJ 切割品質

使用該原理的應用在金屬遮罩（mask）的切割，其優點：

1. 很好的切割品質
2. 沒有碎片
3. 不需後處理的需求
4. 很低公差
5. 工件沒有熱效應, 不會彎曲或溫度變形
6. 不會劃傷, 沒有機構危險

圖十金屬遮罩（mask）加工後的成品

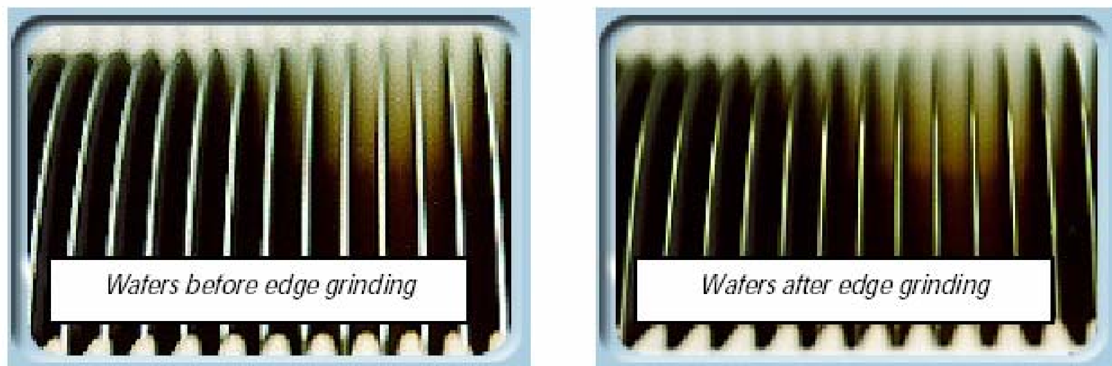


Stencil

圖十. 金屬遮罩的工件

其他使用該原理，應用在邊角研磨、矽晶圓銑槽、鑽孔、銑四方槽等均可作到；圖十一矽晶圓邊角研磨前及邊角研

磨後比較，圖十二晶圓邊角研磨前形狀及邊角研磨後形狀。



圖十一.矽晶圓邊角研磨前及邊角研磨後比較

圖十二.晶圓邊角研磨前形狀及邊角研磨後形狀

本項技術對本所未來研發晶圓製程設備開發相關機台有很高參考價值；在本所研發印刷電路板的雷射切割機及機械手臂的開發基礎下，只要引進該雷射透過水柱導引技術(recipe)應可開發出相關機台。

(三) 半導體設備評估(SEA)計畫

IST(Intonation Society of Technologies)公司，有一項半導體設備評估簡稱SEA(Semiconductor Equipment Assessment)計劃，大約有60項主要設備計畫在執行，包括沉積／成長（Deposition/Growth)、微影

（Lithography）、蝕刻(Etch)、清潔（Cleaning）、相互連接程序（Interconnect process）、分析／計量學（Analysis/Metrology）、組裝及測試（Assembly and Test）等項目，SEA 辦公室設在英國牛津的 Rutherford Appleton 實驗室，本次在展覽會上提供參觀者一份 2000 至 2002 年共有 24 項計畫，每項計畫都有提供計畫目標與規格及研發成果，其中與本院目前研究較相關，在沉積／成長（Deposition/Growth）方面，由於化學氣相沉積製程期間所發生的步驟包括(1).先驅物(precursors)由反應室之入口傳送至晶片附近(2).這些氣體反應形成分子(3).這些反應物傳送至晶片之表面(4).表面反應以釋放矽(5).解除氣態副產物之吸附(6).將副產物傳送離開晶片之表面(7).將副產物帶離反應器等步驟;對於簡單的熱 CVD 製程的一些修正，提供了另類的能源如電漿或光學激發等，在可用來驅動化學反應，使得沉積製程可以在低溫下進行，即有電漿輔助化學氣相沉積(Plasma-Enhanced Chemical Vapor Deposition, PECVD)，或低壓化學氣相沉積(Low Pressure Chemical Vapor Deposition, LPCVD)，SEA 計畫中的「Low Energy 300mm PECVD Hetero-Epitaxy」計畫之規格如表一，可供為本所在研發半導體前製程設備之化學氣相沉積 CVD(Chemical Vapor Deposition)釐定規格參考。

Target Process Specifications

300 mm virtual substrate	
Deposition rate at 550°C substrate temperature	0.5 to 5 nm/sec
Ge relaxed thickness uniformity on 300 mm (1 sigma)	10%
Relaxation degree for buffer layer	100%
SiGe relaxed uniformity in thickness and composition (1 sigma) for (Ge) < 50%	15%
Interface contamination for C and O	< 10^{11}/cm^2
Metal contamination	< 10^{10}/cm^2
Density of threading dislocations on Si epi at 550°C	< 100/cm^2
B doping for > 30% SiGe alloy	up to 5.10^{19}/cm^3
As or P doping for > 30% SiGe alloy	up to 5.10^{18}/cm^3
SiGe threading dislocation density for:	
[Ge] < 20%	< 10^5 dis/ cm^2
[Ge] < 100%	< 10^6 dis/ cm^2
Added particles > 0.3 μm per ø 200mm wafer for SiGe (10%)	< 100
100% Ge on 200 mm silicon substrates for GaAs applications	
Thickness uniformity	10%
SiGe threading dislocation density for [Ge] < 100%	< 10^6 dis/ cm^2

表一.SEA 計畫中的「Low Energy 300mm PECVD Hetero-Epitaxy」規格

蝕刻(Etch)方面,SEA 計畫中的「System/Process for Etching with more than Double Etch Rate」計畫，係研發高比率的深層反應離子蝕刻（high Rate Deep Reactive Ion Etch）簡稱 DRIE，其機台架構如圖十三，使用 Alcatel 專利的感應耦合電漿離子蝕刻(Inductively Coupled Plasma-Reactive Ion Etching, ICP-RIE)，在製程上目標可達到很高的矽蝕刻率，原來 4μm/min－＞8μm/min 故稱 Double Etch Rate，工件在深寬比(aspect ratio) 50:1 時不會過切（undercut），且有一系列的 Beam 型狀可達到深寬比(aspect ratio) 90:1 如圖十四使用 DRIE 加工工件，另對遮罩（mask）材料同時俱有選擇性(Selectivity)，即對不同材料之蝕刻速率的比，俱有不同的蝕刻率，如光阻遮罩(resist mask) 選擇性 150:1，熱氧化物(thermal oxide) 為 450:1，上述之特性可作為本所研發蝕刻之最新指標。

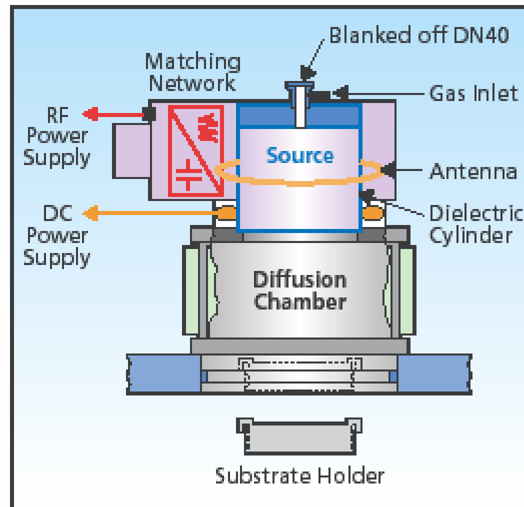


Fig 1. Schematic view of Alcatel 601E process module

圖十三.DRIE 機台架構

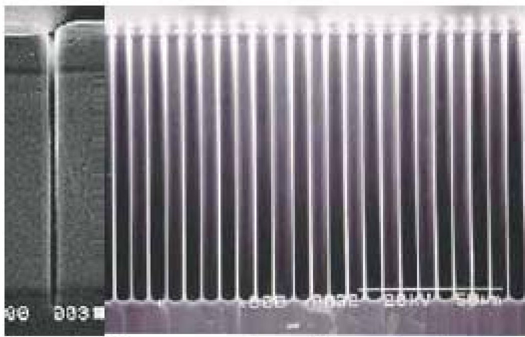


Fig. 3 High Aspect Ratio Etching using the A601E DRIE Etcher

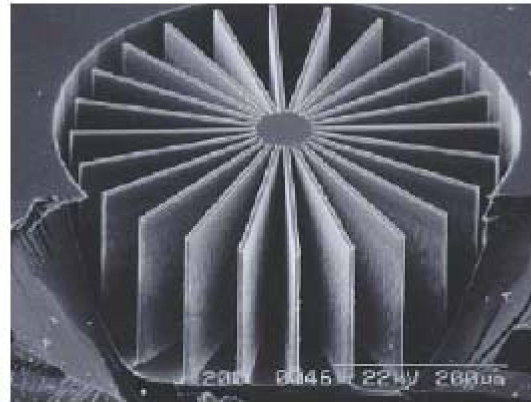


Fig. 7 Deep Wafer Etching using the A601E

圖十四.使用 DRIE 加工工件

二. 參訪德國著名之漢諾威雷射應用研究中心 LZH e.V.(LASER ZENTRUM HANNOVER e.V.)公司

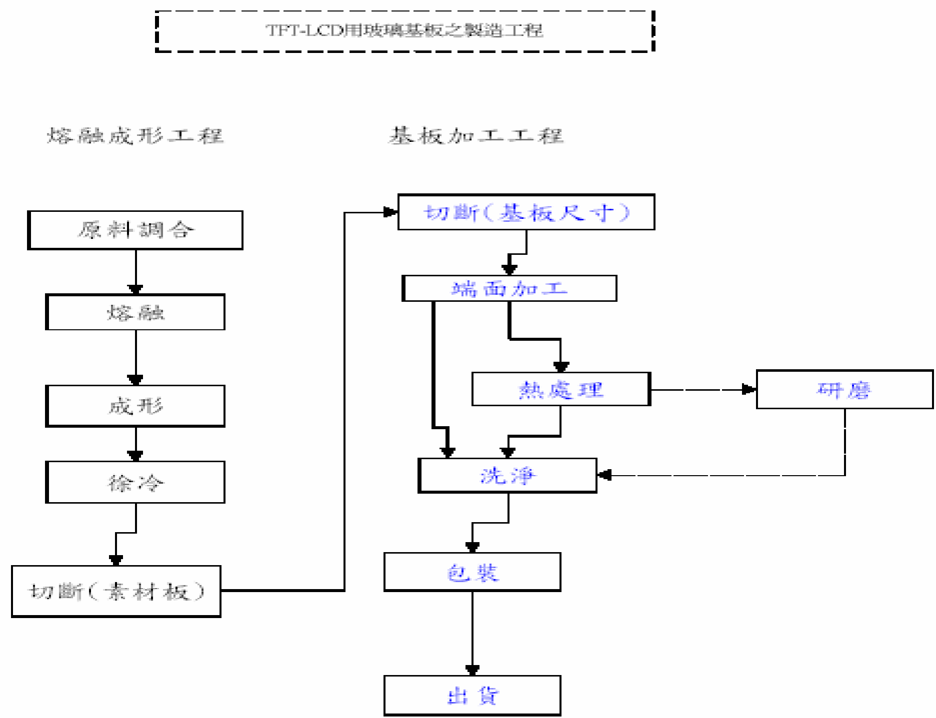
(一).TFT-LCD 應用及傳統製造方法

隨著台灣資訊工業在世界上揭起,當所有的數位化資訊能夠經由 LCD 的科技，快速及有效的傳送到您我的眼前，讓我們的生活更為自在和便利，因此，LCD 是扮演著一個非常重要的角色，就是“LCD”引導我們的生活進入一個全新的數位化世界，由於未來 LCD(Liquid Crystal Display) Monitor 將取代 CRT Monitor 已成

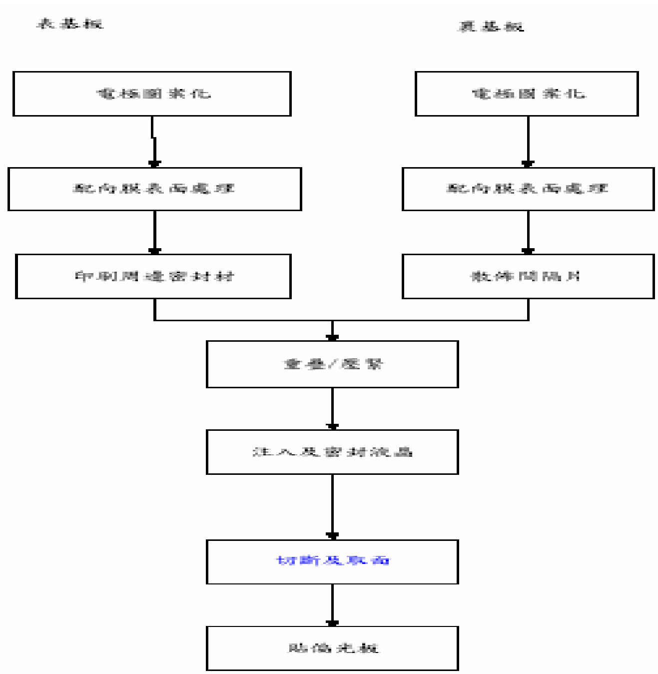
為趨勢，在 LCD 用玻璃基板應用領域如表二範圍相當廣泛；TFT (Thin Film Transistor) LCD 用玻璃基板之製造流如圖十五及 LCD 單元製造流程如圖十六。

使用領域	產品	超廣角 TFT	非晶系 TFT	STN	TN	反射式	高溫多晶系	低溫多晶系
監視器	超廣角液晶顯示器	●						
	桌上型液晶顯示器		●	●				●
	液晶監視器		●	●				●
攜帶性資訊	筆記型電腦		●	●				●
	迷你筆記型電腦		●	●		●		
	掌上型電腦		●	●		●		
	個人數位助理		●	●		●		
	衛星導航系統		●	●			●	●
	攜帶式電話			●	●			
消費性	液晶電視機		●					●
	液晶投影顯示器		●				●	
	數位相機		●			●		●
	數位攝影機					●	●	

表二. 玻璃基板應用領域



圖十五.TFT (Thin Film Transistor) LCD用玻璃基板之製造流程



圖十六.LCD 單元製造流程

由 LCD 用玻璃基板之製造工程，及 LCD 單元製造工程，

均需作玻璃切割，傳統的玻璃切割使用鑽石或鎢碳刀在玻璃表面施於力道使表面產生裂痕再由人員或機器折斷，四個邊界會有鋸齒狀，必須經過修邊研磨，換邊研磨，清洗，風乾等程序，邊緣易造成殘留應力，影響 LCD 壽命，為什麼使用 laser 加工詳如下圖比較。

	機械劃線法	Laser 切割
刀具	鑽石或碳化鎢輪刀	Laser
消耗性成本	高	低
表面損害（側面裂痕）	有（刀具與表面接觸）	沒有
微粒	有	沒有
端面	不完美	完美
增加後處理	破裂處理 研磨處理 清洗處理	不需要增加後處理
準確性	低	高

由國外 laser 加工機與相關文獻顯示 Laser 加工具有下列優點：

- 切割 ITO 雙塗料層玻璃沒有任何限制
- 可切割任何形狀顯示器玻璃(除石英外)不需要重新排列
- 提供非常穩定的切割線與高品質的邊端
- 切割線微層變窄
- 切割時沒有吱吱喳喳聲不會產生玻璃微粒
- 玻璃表面不會過熱,長期間邊界不會有微小裂痕
- 沿著膠合密佈線切割沒問題
- 過切時不會有吱吱喳喳聲
- 表面不會有刮傷,玻璃基材沒有接觸工作台表面.

- 能處理微小基材
- 生產線不需要再研磨和清洗
- 雷射切割機械比一般機器空間小 4 倍
- 不需要分割剝離系統
- 不需要二面翻轉台
- 不需要二台剝離設備

但目前國內尚未具備設計製造 Laser 加工玻璃機台能力，配合國內顯示器製造大廠有意委託本所開發使用雷射切割 TFT 玻璃之研究，特別利用前往德國參觀歐洲國際半導體設備及材料大展 （SEMICON Europa 2004）與漢諾威 messe 2004 的工廠自動化展期間,拜訪 LZH e.V. 公司，並瞭解該公司對玻璃切割最新技術，以利作為未來引進該技術或合作開發之參考。

(二)·LZH 公司參訪紀要

四月 23 日早上 8 點 50 分到達該公司，與該公司人員會面寒暄後，聽取 Michael Haase 先生簡報，該公司的組織架構共分成四大部門，分別

1. 雷射元件部門，該部門主要研究課題
   - ·高能量雷射系統的電渡
   - ·薄膜程序的應用
   - ·最低光 lose 的電渡
   - ·特殊電渡的研發
   - ·雷射元件的特性依據 ISO 標準

2. 雷射研發部門，該部門主要研究課題
   - ·二極體雷射
   - ·二極體固態雷射

・光纖雷射
・非線性光學
・計量學（metrology）的雷射源
・超短波雷射
・醫學應用的雷射源

3.生產和系統部門，該部門主要研究課題
・系統和控制技術
・程序控制
・CAD/CAM 技術
・製造度量衡
・使用 UV 雷射光纖雷射及 fs 雷射波對微程序
・玻璃和陶瓷程序
・模擬技術
・對 SME 中心的測試和諮詢

4.材料和程序部門，該部門主要研究課題
・切削和熔接技術
・表面處理和磨損保護
・聚合物程序和新材料
・雷射系統和特殊程序手冊
・生產過程的安全技術和分析
・過濾技術
・程序分析和品質控制
・雷射光學建構和設計

另外該公司有表三各種雷射源，第一行為雷射型態，第二行為雷射波及能量，第三行為製造公司及機型，第四為雷射機台特性，由上述組織架構與各式各樣的雷射，可看出該公司在雷射應用領域投資及發展含蓋之廣。

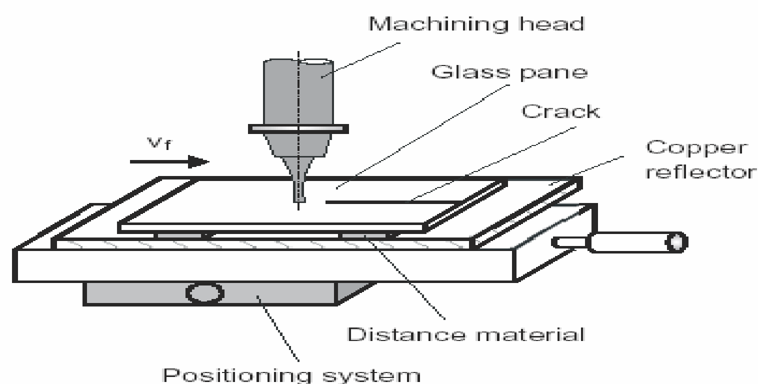
Lasertyp	Leistung/Pulsenergie	Hersteller	Laserperipherie
CO_2-Laser	6000 W (DC)	Wegmann-Baasel TRIAGON 6000	5-Achsen-Portalsystem oder 3-Achsen-Station
	2500 W (HF)	Rofin-Sinar DC 025	4-Achsen-Schneidanlage (Behrens CB2500)/ 4-Achsen-Station (lineardirektangetrieben)/ 4-Achsen-Station
	1500 W (DC)	Rofin-Sinar RS 1500	4-Achsen-Station
	750 W (HF)	Trumpf TLF 750	Laserzelle (Trumpf TLC 462)
	500 W (HF)	Coherent K 500	4-Achsen-Station/Scanner/ 3-Achsen-Schneidanlage
	250 W (HF)	Coherent K 250	4-Achsen-Station/Scanner
	240 W (HF)	Melles Griot CRF 2400	4-Achsen-Station/Scanner
	200 W (HF)	Rofin-Sinar SC x20	4-Achsen-Station/Scanner
	50 W (HF)	Synrad	Beschrifter
	25 W (HF)	Synrad	
	6 J (TEA)	ALLTEC ALLMARK 880	
Nd:YAG-Laser	4000 W (cw/pw)	Haas 4006 D	über LWL wahlweise Betrieb auf 5 Bearbeitungsstationen oder 2 Roboter
	2200 W (cw) diodengepumpt	Rofin-Sinar DY 022 L	
	2000 W (cw/pw)	Rofin-Sinar CW 020	
	1000 W (pw)	GSI Lumonics JK1002	
	500 W (pw)	Rofin-Sinar RSY 500 P	
	600 W (pw)	MLS P 500 (Stablaser)	3-Achsen-Station
	220 W (pw)	Lasag SLS 200 C 60	4-Achsen-Station/LWL
	100 W (cw)	Rofin-Sinar RS Marker 100 D	Beschrifter
	22 W (pw)	Baasel SC 18	4-Achsen-Station/Scanner
	20 W (pw)	Beck-Scheibenlaser	4-Achsen-Station
	8 W (1064 nm) 5 W (532 nm) 3 W (355 nm) 1 W (266 nm)	Lambda Physik Starline 2030	2-Achsen-Station Ultrapräzisionssystem
	7 W (pw)	Coherent Avia 355-7000	4-Achsen-Station/Scanner
	2 W (pw)	Coherent Avia 266-7000	4-Achsen-Station/Scanner
	4 W (355 nm/pw) diodengepumpt	Adlas Coherent DPY501	4-Achsen-Präzisionsstation/ ELPECmat 5-Achsen-Koordinatentisch
Hochleistungs-Diodenlaser	1.2 kW cw (808 nm)	Rofin-Sinar DL 015	3-Achsen-Station
	300 W (940nm)/ 250 W (Fasergekoppelt)	Laserline LDF 600-250	direkter Strahl/Faserkopplung/Scanner
	100 W cw (1 KHz; 810 nm)	Fok. Diodenlaser Fisba DL 100	6-Achsen-Roboter
	15 W (810 nm)	Fasergekoppelter Diodenlaser SDL FB 25	2-Achsen-Station
	9 W (1064 nm)	Faserlaser SDL FD 10	

Lasertyp	Leistung/Pulsenergie	Hersteller	Laserperipherie
Excimerlaser	0.6 J/248 nm	Lambda Physik Lambda 4000	ELPECmat
	0.8 J/250 Hz/248 nm	Lambda Physik LPX 325	Wahlweise: Mikrobearbeitungsstationen ELPECμ oder ELPECmat/3-Achsen-Koordinatentisch
	0.6 J/100Hz/248 nm 0.3 J/100 Hz/351 nm	Lambda Physik LPX 210	
	0.3 J/300 Hz/193 nm	Lambda Physik LPX 325	Mikrobearbeitungsstation ELPECm
	30 mJ/200Hz/157 nm	Lambda Physik LPF 220	Vakuumkammer mit 4-Achsensystem
	8 mJ/193 nm	TUI-Laser Existar S 500	ELPECmat
	1.5 mJ/157 nm	TUI-Laser Existar S 500	Vakuumkammer mit 4-Achsensystem
Titan-Saphir-Laser	2 mJ (150 fs; 1 kHz) 0.5 mJ (150 fs; 5 kHz)	Spectra Physics Spitfire	4-Achsen-Koordinatentisch/Scanner
	0.5 mJ (150 fs; 1 kHz)	BMI Alpha-1000	
	1 mJ (150 fs; 1 kHz)	Clark-MXR CPA 2001	
	0.8 mJ (30 fs; 1 kHz)	Femtolasers COMPACT-PRO	
	0.3 mJ (150 fs; 5 kHz)	Thales CONCERTO	
	4 μJ (160 fs; 250 kHz)	Coherent RegA 9000	

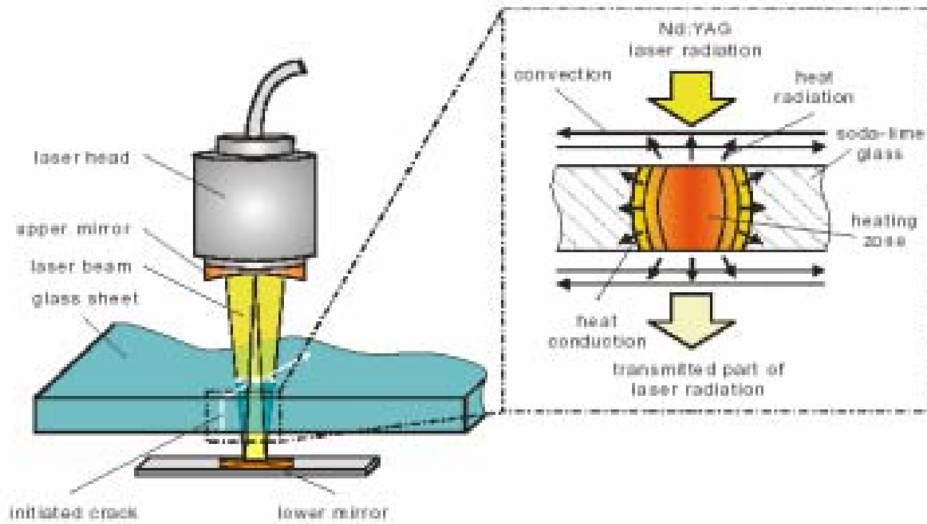
表三.LZH 公司各種雷射源

本次參訪下午由 Michael Haase 先生帶領我們參觀該部門各種雷射應用，在大型雷射源可看到將一台雷射源利用光纖導引分到不同試驗機台，以充分利用昂貴的雷射源，在雙層玻璃切割使用 Rofin-Sinar DY 022 型雷射源，在試驗機台如圖十七，一個簡單機台，在機台上方平放一面銅板當作低反射鏡，在銅板上方所謂 distance Material 現場看到為透光性很好的材質，類似玻璃或壓克力板，再將被切割的玻璃平放在上方，利用圖十八，所謂多重雷射光束吸收 MLBA(Multiple Laser Beam Absorption) 方式切割，其工作原理係利用透明物質對低波長雷射光，低吸收率的特性，在製程上，將雷射光予以多重反射，造成雷射光在物體中，因多重反覆而被多重吸收，進而產生高熱而熔解；由於在物質上、下表面，有自然熱散逸的現象，而內部仍保持高熱，所以外冷內熱造成物質的脆裂，達成切割的目的。

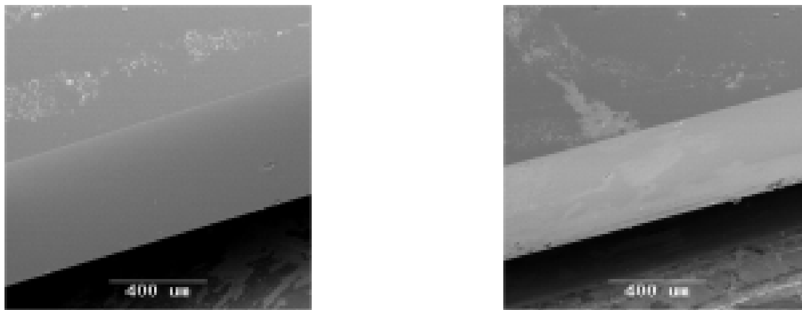
目前公佈的切割數據，可達數米每秒的速度。此外，使用的雷射源，為較便宜的 Nd:YAG，波長 1064 nm 的雷射，大幅提高其可能的實用性；實際玻璃切割端面如圖十九，切割速度約為 1 m/min，且切割品質相當不錯，圖廿為二片各 0.7mm 厚度玻璃膠合後僅切割上層玻璃。



圖十七.Multiple Laser Beam Absorption 的試驗機台



圖十八.Multiple Laser Beam Absorption 的工作原理



圖十九.使用 Multiple Laser Bea Absorption 試切鍍鉻玻璃的切割結果

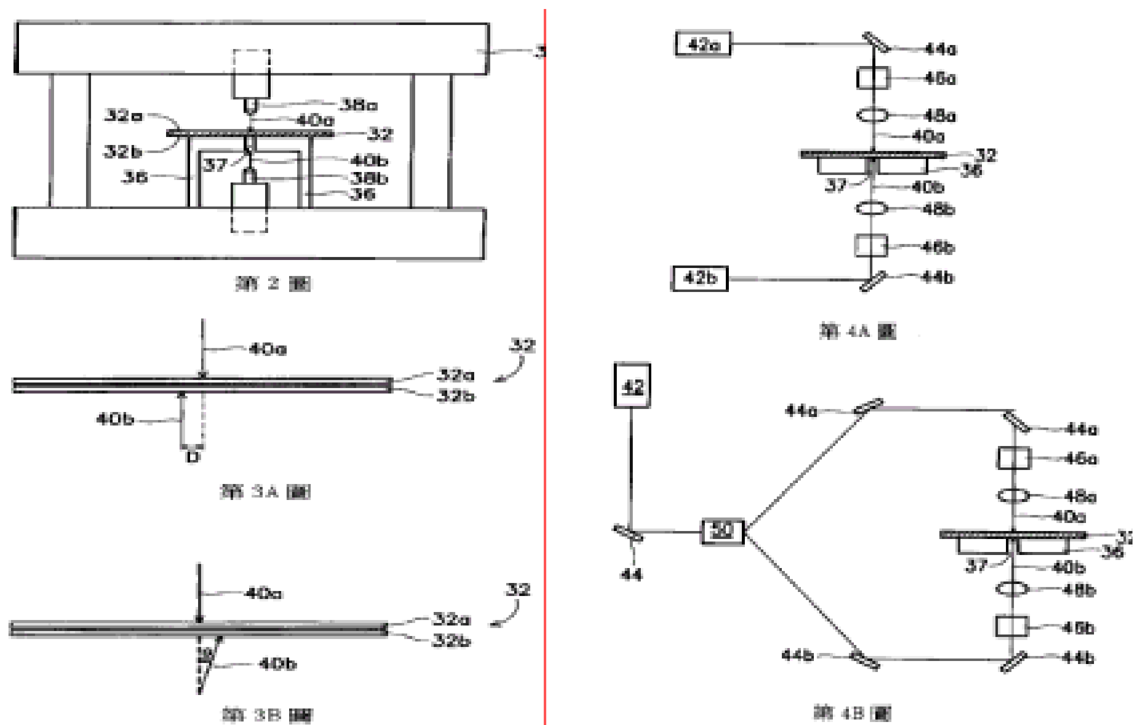
圖廿. 僅切割上層玻璃

(三)·雷射切割玻璃之方法比較

從LZH公司所研發MLBA切割法及蒐集各國研究雷射切割相關專利資料如下七篇資料，作比較均不同。

1. 以雙雷射設計來分割雙層玻璃基板之疊層物的裝置:

該篇係用來切割由雙層玻璃基板所構成之疊層物，該裝置包含有一光束分光器所產生之原始雷射光束分成二雷射光束，對雙層玻璃基板所構成之疊層物，上下同時切割，其中第一雷射光束之入射角與第二雷射光束之入射角之偏移介於0º與20º之間，詳如圖廿一。

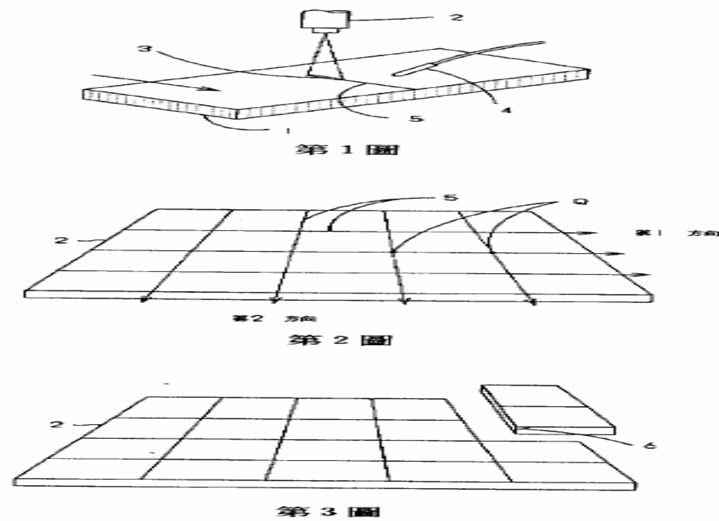


圖廿一.以雙雷射設計來分割雙層玻璃基板之疊層物的裝置

2.使用雷射之刻劃法：

該篇係一種使用雷射之刻劃法，於脆性材料之基板

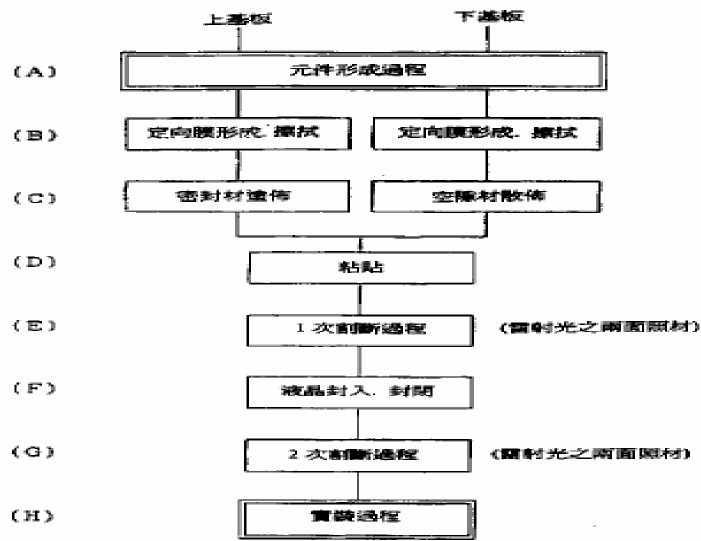
照射、藉熱變形於基板上形成裂痕，主要係控制使第 2 方向之雷射輸出比第一方向降低 10-40%，移動速度比第一方向降低增加 110-140%，使裂痕深度較淺，如圖廿二。

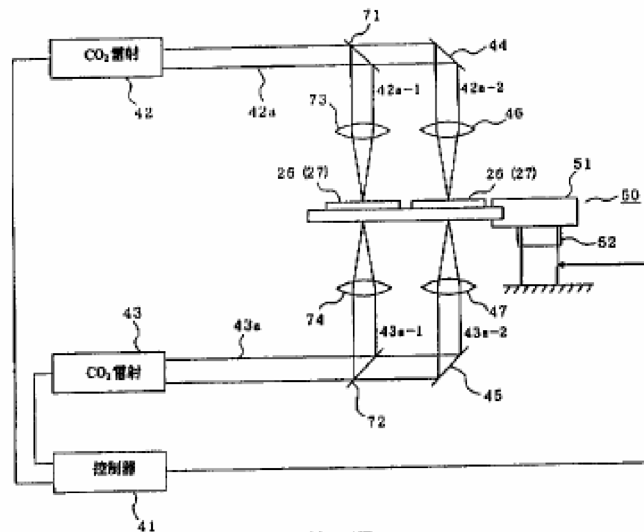


圖廿二. 使用雷射之刻劃法

3. 雷射割斷方法, 雷射割斷裝置, 液晶裝置之製造方法以及液晶裝置之製造裝置：

該篇對液晶裝置之製造方法如以下之流程圖，提出對玻璃系基材使用 CO_2 雷射切割，矽系使用 YAG 雷射切割，並利用雷射光分別分歧為複數光線，並將分歧的複數條光線照射於基板之複數處，以同時進行基板之複數處之割斷，如圖廿三。

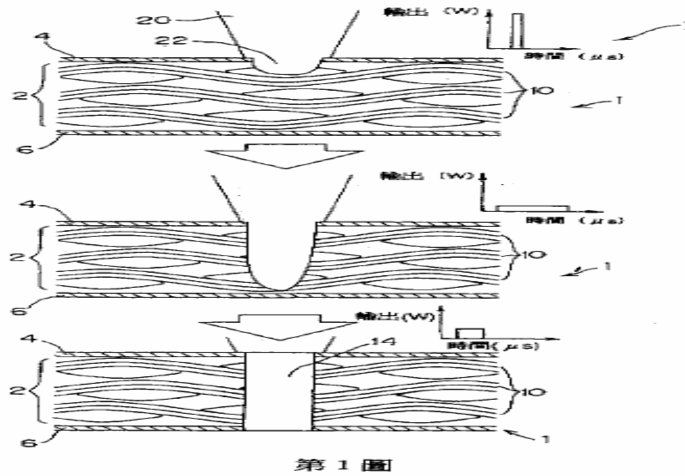




圖廿三. 雷射割斷方法,雷射割斷裝置,液晶裝置之製造方法以及液晶裝置之製造裝置

4.積層材料之雷射加工方法及裝置：

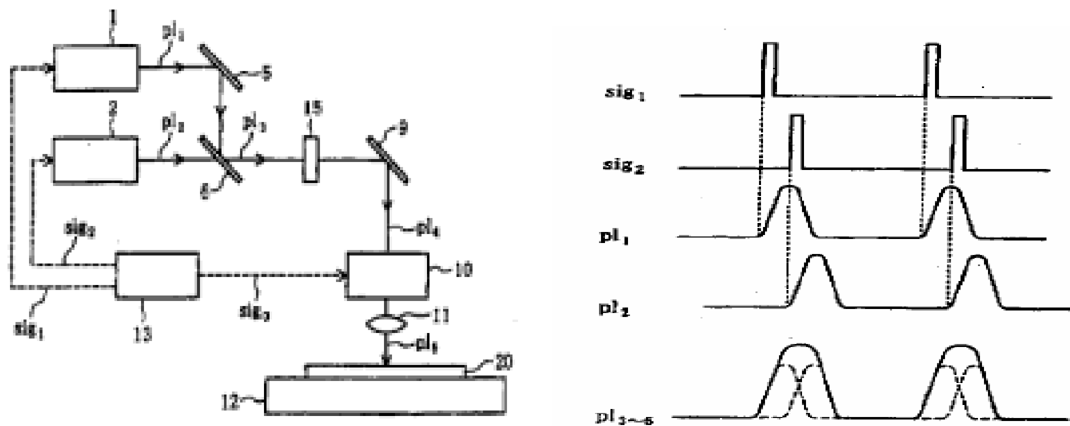
該篇係藉由雷射來加工積層1個以上之導體層及絕緣層的積層材料，特徵係對不同材質利用不同輸出W數與不同雷射束照射時間，來進行穿孔加工，如圖廿四。



圖廿四. 積層材料之雷射加工方法及裝置

5. 雷射加工裝置及加工方法：

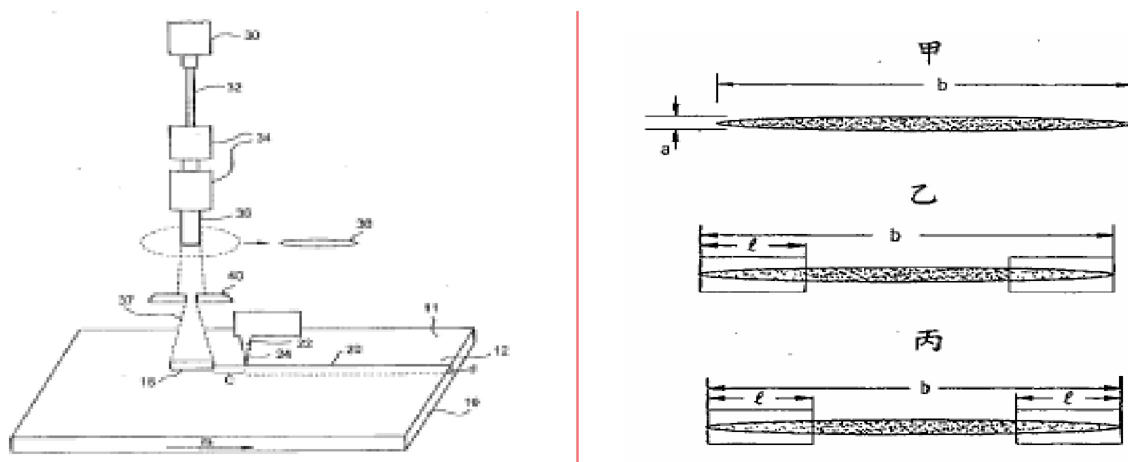
該篇特徵係可輸出具週期性波形，將第一脈衝雷射束及第二脈衝雷射束聚於同一點之聚光光學系統，並使第二脈衝雷射束至少一部分重疊於第一脈衝雷射束之脈衝到達加工位置，目的系對多層配線基板開孔，利用第一能量之紫外線脈衝雷射束能源開孔第１層，再藉比第一能量為高之第二能量之紫外線脈衝雷射束能源開孔第２層，如圖廿五。



圖廿五. 雷射加工裝置及加工方法

6. 控制雷射劃線介質深度之方法：

該篇特徵係利用一個或多個透鏡將第一光束轉變而成第二光束，其在投射玻璃上具長軸及短軸之拉伸橢圓形光束，在第二光束可一端或二端處物理性地封閉以減少身長，第二光束點之長軸形成第三光束，移動第三光束通過玻璃表面形成加熱玻璃，並由噴嘴噴出冷卻劑於加熱玻璃使玻璃形成裂縫，改變冷卻距離以有效控制裂縫深度，如圖廿六。



圖廿六. 控制雷射劃線介質深度之方法

7.METHOD OF SPLITTING NON-METALLIC MATERIALS：該篇特徵係利用透鏡使雷射聚光，成橢圓形如圖廿七，以增加切割深度，依專利說明各參數：

a=0.2 to 2.0 h

b=1.0 to 10.0 h

V=ka(b+L)/d

V is the rate of relative displacement of the beam spot and the body

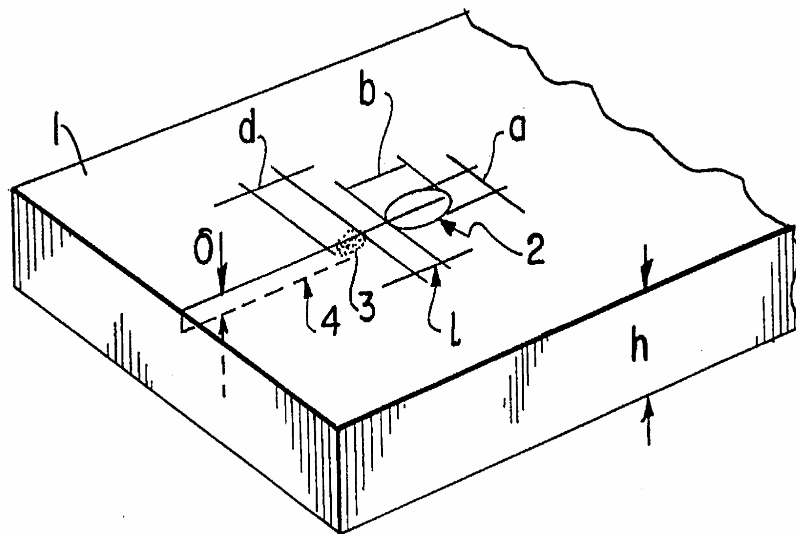
K is a proportionality factor dependent on the thermo physical properties of the material and the power density of the beam

a is the width of the beam spot on the material surface

b is the length of the beam spot

L is the distance from the rear edge of the beam spot to the front edge of the cooled zone

d is the depth of the blind crack



圖廿七.說明 METHOD OF SPLITTING NON-METALLIC MATERIALS 方法

美國 P.T.G.(Precision Technology Group)公司，已上市之雷射切割玻璃機台使用上述 6,7 方法將雷射聚焦成橢圓形，在前方的橢圓形尖端俱有預熱(preheat)，後方的橢圓形尖端俱有回溫(reheat) ，並在雷射光後面利用水冷卻使玻璃達到脆裂；另美國 USDC (United States Display Consortium)曾於 1997 年委託位於 Florida 的公司，Accudyne Corp.進行雷射玻璃切割的研究。官方資料顯示，總研發金額為 US$6.2 million，研發期程 2 年。另雜誌的資料顯示，總研發金額為 US$4.5

million，由 USDC 與 Accudyne Corp.各出資 50%，期程為 2 年；而 2001 年，韓國 LG 公司宣告使用雷射進行玻璃切割的機台，研發成功。

由上述各種研究使用雷射對玻璃切割之可能方法及方式，顯示該領域各國均積極投入，目前正是切入參與研發的好時機。

三.參觀漢諾威 MESSE 之工廠自動化展(FACTORY AUTOMATION)

本次參觀漢諾威大展（Hannover MESSE)，內容含有下列八大類，以利參觀者依自己專長背景及需求，選擇前往參觀；由於半導體工業對工廠自動化的需求越來越高，主要係半導體工業已朝向將各模組化的設備加以整合在單一機台上，並利用自動化，提高產量，縮小佔地面積，因此，本次重點在工廠自動化，另外順便參觀其他展覽。

1. interkama+ --針對程序自動化
2. Factory Automation—針對生產自動化
3. Energy—針對能源技術延長能源(renewable Energy)
4. Surface Technology plus Powder coating Europe—歐洲表面處理技術
5. Subcontracting—機械工業和自動車工業和工廠設備工業的分包服務與材料
6. Digital Factory –整合程式和 IT(Information Technology)資訊技術
7. Micro Technology—微系統技術與奈米技術
8. Research & Technology—針對基礎科學研究，源始研究的應用，研究服務及技術轉移，內容包括光學技術、奈米科技、航空、新材料、微系統技術、生命科學等包羅萬象，本項展示對學生尤其高中生參觀俱有啟發作用。

從展示區分縱深之廣，可看出參展廠商之多，由大會所獲得資料統計有5千家以上，共計16個展示館，其中工廠自動化展分佈在七個展覽館，該項計有36個國家的1000家廠商參展，可說是盛況空前，該展示期由4月19日至24日，由於扣除來回班機時間，在德國實際僅停留5天，時間緊湊，該展示只能在最後一天24日前往參觀；在工廠自動化展示中最震撼是第十七館 "Automation Live"可看到汽車製造中各種工業機械手臂自動作焊接，而機械手臂的移動路徑，已進步到使用3D立體模擬，將整台車及機關手臂建立立體模型，同時利用依據要加工或焊接部位，從模型中模擬路徑過程直接顯示在螢幕上，是否有干涉到其他部位，可一目了然，其他較特殊的如下說明。

（一）. micromotion 公司的精密微小傳動裝置

在蒐集資料中，micromotion 公司的精密微小傳動裝置（Precision Microactuators）如圖廿八精密微小傳動裝置與10、20cent 歐元比較，其中微小齒輪箱且中空傳動軸之伺服傳動裝置，有 MHD-8,MHD-10 二種模式，分別代表直徑8mm 與 10mm，其減速比可達到有160:1 至 1000:1，重量僅2.2克至5.7克，規格如表四，一般常應在光學、醫學設備、光學通訊、半導體、機器人、雷射技術、生物技術等。

圖廿八.精密微小傳動裝置與10、20cent 歐元比較

Tabelle 1	Table 1		MHD-8		MHD-10		
Untersetzung	Reduction ratio		160:1	500:1	160:1	500:1	1000:1
Nenndrehmoment	Rated torque	mNm	3	8	5	13	20
Spitzendrehmoment	Peak torque	mNm	6	16	10	26	40
Kollisionsdrehmoment	Momentary peak torque	mNm	20	40	23	64	100
Verlustdrehmoment (Motoranbauvariante)	Friction torque (version for motor)	μNm	30	35	50	45	40
Verlustdrehmoment (Antriebswellenvariante)	Friction torque (version with input shaft)	μNm	70	75	90	85	80
Wirkungsgrad bei Nennbetrieb (Motoranbauvariante)	Efficiency at rated operation (version for motor)	%	63	74	67	80	82
Wirkungsgrad bei Nennbetrieb (Antriebswellenvariante)	Efficiency at rated operation (version with input shaft)	%	42	57	53	67	70
Nennantriebsdrehzahl	Rated input speed	1/min rpm	10000	10000	10000	10000	10000
Maximale Antriebsdrehzahl	Maximum input speed	1/min rpm	30000	30000	30000	30000	30000
Abtriebswelle Maximale radiale Last (stat.) Maximale radiale Last (dyn.) Maximale axiale Last	Output shaft Max. radial load (static) Max. radial load (dyn.) Max. axial load	N	15 3 10	15 3 10	20 5 10	20 5 10	20 5 10
Antriebswelle Maximale radiale Last Maximale axiale Last	Input shaft Maximum radial load Maximum axial load	N	5 10	5 10	5.5 10	5.5 10	5.5 10
Massenträgheitsmoment Motoranbauvariante Antriebswellenvariante	Moment of inertia Version for motor Version with input shaft	gcm^2	7×10^{4} 38×10^{4}	8×10^{4} 38×10^{4}	23×10^{4} 60×10^{4}	22×10^{4} 59×10^{4}	18×10^{4} 55×10^{4}
Gewicht Motoranbauvariante Antriebswellenvariante	Weight Version for motor Version with input shaft	g	2.2 3.5	2.2 3.5	4.5 5.7	4.5 5.7	4.5 5.7

Genauigkeitsdaten　　**Accuracy Data**

Tabelle 2	Table 2		MHD-8		MHD-10		
			160:1	500:1	160:1	500:1	1000:1
Wiederholgenauigkeit	Repeatability	arcsec	±10		±10		
Verdrehsteifigkeit	Torsional stiffness	Nm/rad	2.29	1.51	8.25	3.23	2.00

表四 MHD-8,MHD-10 規格

(二). FEINMESS DRESDEN公司的各類移動平台

FEINMESS DRESDEN公司的各類移動平台（motion system），如圖廿九，其傳動馬達分別有直流馬達（DC-motor），步進馬達（Stepper motor），壓力陶磁

馬達（Piezo -ceramic motor）,無鐵磁心線性馬達(Ironless synchrony linear motor);解碼器(encoder)分別有Rotary encoder, liner encoder；其中比較精密線性移動平台如PMT160-050-EDLM，精度(Accuracy)可達到1.5μm,重複性精度(Repeatability) 0.3μm,最大速度（max.speed）500mm/s，最大加速度（max.acceleration）10m/s^2；比較精密旋轉平台如DT105-4LM，精度(Accuracy)可達到0.005deg,重複性精度(Repeatability) 0.0005deg，最大速度（max.speed）60deg/s，最大加速度（max.acceleration）>10000deg/s^2。

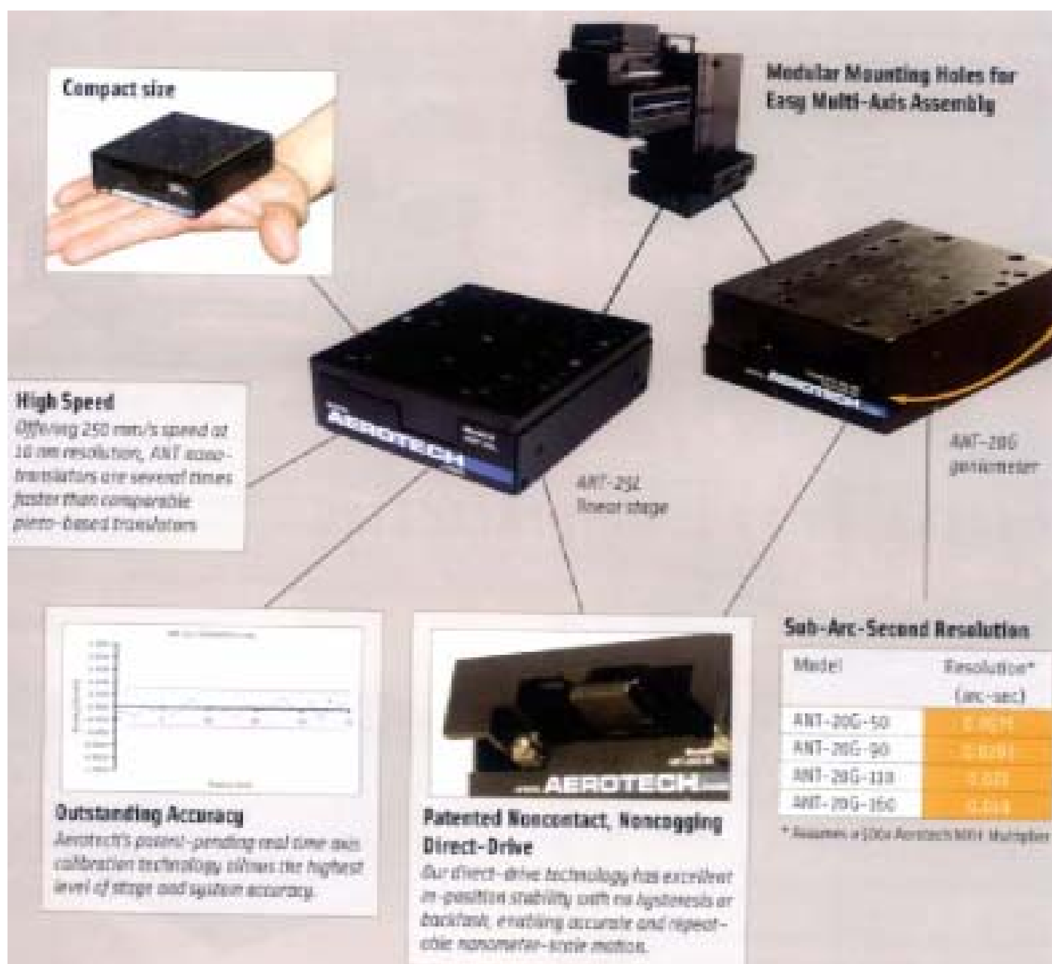
圖廿九. 各類移動平台（motion system）

(三). DELTA TAU 公司的運動控制卡

DELTA TAU 公司的運動控制卡，使用 motorola 56k 系列的 DSP（Digital Signal Processor），CPU 速度從 40 到 240MHz，同時執行 16 個 motion programs 和 64 個 PLC(logic) programs，並利用該公司稱 MACRO link 作為運動控制卡與驅動器之間透過光纖可達 3000 米之遠，125Mbit/sec 的通訊速率作控制，而 MACRO 係 Motion and Control Ring Optical 的縮寫，優點可作長距離的控制。

(四). AEROTECH 公司奈米級精密移動平台

AEROTECH 公司有一精密移動平台達到奈米級解析度，如圖三十，速度 250mm/s,作到 10nm 解析度，尺寸之小可放在手掌上，其他有關電子製造、測試和檢驗等解決自動化之元件及其應用，僅作說明未附詳細規格，若要詳細規格需上該公司網站 www.aerothec.com 查詢。



圖三十.奈米級精密移動平台

由於在自動化控制的主要元件，分別為運動控制卡、驅動器、伺服馬達、步進馬達，因此，將蒐集此類比較特殊作介紹，而從各項實物之微小，作為本所研究 MEMS 的參考。

另外針對 SEMI 協會在展示期間進行各種國際標準的技術委員會所研擬及修訂之資料，及各廠商在 e-Manufacturing 和 e-Diagnostics 二項領域簡報資料，如附件供有需要人員參考，以利瞭解最近狀況。

參、效益分析

在我國政府所提的二兆雙星之願景，其中之半導體產業與平面顯示器產業，每年市場將各可達一兆以上之規模，而這兩

兆之基礎必需依賴良好的製程設備，每年我國均付出可關的外匯進國相關設備，因此，發展半導體製程設備，奠定半導體製程設備的自製能力，為我國科技產業重要項目之一。

另外平面顯示器製程中的玻璃切割，未來平面顯示器朝向越來越大，若未對切割技術突破，仍然使用傳統鑽石刀頭作劃線、剝離，在玻璃端緣會產生不平直，除增加圓磨後處理程序，對生產良率與平面顯示器壽命均會影響，本次的參觀及參訪，針對此議題，瞭解世界未來的趨勢和掌握，是有絕對正面性的效果。

雷射在材料加工的應用範圍相當廣，從金屬材料、非金屬材料、半導體材料到特殊複合材料加工；雷射不僅可作微孔加工，如印表機的噴頭孔徑之類，精密焊接、劃線、微雕刻；從傳統加工到半導體元件之光蝕刻、缺陷修補、焊接、標誌刻劃到表面處理等範圍之廣，近年來更發展到微機電系統（MEMS）的製作，而微機電系統為科技界認為是未來前瞻性研究領域，因此，在微細加工（micromachining）中，雷射加工機是其製程的基礎設備，本次能獲得 Laser with water jet 相關資料，作未來科專計畫，在雷射機台研發，將有更寬廣的構思及設計。

肆、國外工作日程表

本次出國起訖日期為 93 年 4 月 19 日至 93 年 4 月 26 日，包括去程與回程共 8 天，國外工作日程表如下。

<table>
<tr><td rowspan="2">項
次</td><td rowspan="2">日
期</td><td rowspan="2">地
點</td><td colspan="4">交往接觸人士及機關
（外文名及譯名）</td><td>洽談內容紀要</td></tr>
<tr><td>姓　名</td><td>國籍</td><td>性別</td><td>地　址</td><td></td></tr>
</table>

1	93.4.19	桃園 ｜ 荷蘭 阿姆斯特					4月19日23:05分班機 去程、轉機
2	93.4.20	荷蘭 阿姆斯特 ｜ 德國 慕尼黑				德國 慕尼黑	轉機(4 月 20 日 14;30 到慕尼黑機場)16:00 到達展示館，依計畫工作行程參觀 2004 年歐洲半導體設備與材料大展(Semicon Euopa 2004)
3	93.4.21.	德國 慕尼黑	各參展廠商，其中代表人士 Christoph Riecker	德國	男	ROFIN-SINAR Laser GmbH Neufeldstr.16 D-85232 Bergkiirchen/ Gunding	蒐集半導體製程設備領域最新發展動態，瞭解市場及技術發展最新趨勢， 洽談laser 應用在玻璃切割及半導體退火製程之技術
4	93.4.22	德國 慕尼黑 ｜ 德國 漢諾威	各參展廠商，其中代表人士 Dominic POTTER	法國	男	1,boulevard de Strasbourg- Parc Gustave Eiffel BUSSY SAINT GEORGES F-77607 MARNELA LA VALLEE CEDEX 3 FRANCE	蒐集半導體製程設備領域最新發展動態，瞭解市場及技術發展最新趨勢， 洽談該公司L-Motion type Slit Valves 新產品之相關規格與特性 下午搭乘火車前往漢諾威

5	93. 4. 23	德國 漢諾威	Michael Haase	德國	男	LZH Machines and Controls Group Hollerithallee8 D-30419 Hannover	研討先進雷射系統在玻璃切割及半導體退火關鍵核心技術等
6	93. 4. 24	德國 漢諾威	各參展廠商,其中代表人士 Norbert Roth	德國	男	Iselautomation KG Burgermeister-Ebert-str. 40 D-36124 Eichenzell	蒐集工廠自動化設備領域最新發展動態,瞭解市場及技術發展最新趨勢,洽詢該公司 Microstepping Drive,HF-Spindle motor 等產品特性規格
7	93. 4. 25	德國 漢諾威 ｜ 英國 倫敦					返程、搭飛機及轉機
8	93. 4. 25	英國 倫敦 ｜ 桃　園					返程、搭飛機

伍、社交活動

本次參觀歐洲國際半導體設備及材料大展（SEMICON Europa 2004）時,在會場中巧遇煒群科技股份有限公司總經理李聖堯 先生，同樣專程前往慕尼黑參觀；互相寒暄交談彼此來參觀目的，均是希望介由參觀歐洲半導體設備展，能進一步瞭解先進國家在此領域市場及技術發展趨勢。

另外與"rofin Laser "公司 Christoph Riecker 先生討論使用 Laser 切割玻璃和使用 Laser 對半導體材料作退火處理技術；在雙層玻璃切割方面，因要求僅上層切斷，不要影響下層玻璃或中間的導線材料，在此領域由於很先進技術，目前還沒有很好解決方案；在 Laser 對半導體材料作退火方面說明，將 laser beam 聚焦成一長線段，利用 laser beam 對工件作來回掃描，控制 laser beam 能量，使其熱能達到對材料退火熱源即可達到退回功能，未來可朝此方向研究。

在慕尼黑等待搭火車前往漢諾威時，在火車站前書店發現以繁體字的『歐洲日報』，該報總社在法國，版面分別有 1.國際要聞 2.法國新聞 3.歐洲新聞 4.台灣新聞 5.兩岸新聞 6.大陸新聞 7.香港新聞 8.亞洲新聞等版面;一份 1.6 歐元，與台灣報紙比較是貴很多，為促使繁體字文化能在世界各地出現，特地購買一份。

在漢諾威火車站遇到榮昇科技股份有限公司總經理 王文壽 先生，該公司前往參展，王總經理帶領少數員工不持辛勞，在國外開闢市場，經瞭解台灣前往參展的企業約有一百家之多，分布在不同展覽館，顯示台灣企業界的活躍。

慕尼黑與漢諾威的地鐵捷運系統四通八達,在出入口均未設置閘門，旅客到自動售票機購票後搭車，票價分別有單人、團體（5 人以內）、單程或一天票(Day Ticket)，並配合區間來計價，二大都市之交通網值得台灣都市學習，尤其慕尼黑除了地鐵捷運，在重要幹線又有多節輕軌車行駛，另郊區有公車接

駁，若買一天票(Day Ticket)，當天只要購買一張票，不限制搭乘次數，且一張票可搭地鐵、轉搭輕軌車或公車，只要在購買的區間內（interior zone）均有效，相當方便。

陸、建議事項

一. 半導體產業及顯示器產業為全球兩大重要產業，並為我國兩大支柱產業，而其製程設備則為此二產業之一項重要核心技術，其於國防科技及產業科技之發展皆具重要地位。

本院二所在前兩期科專計畫中在半導體高密度電漿機台，晶圓輸送系統，晶圓平坦化機台，快速熱處理機台及關鍵組件如真空機械手臂及磁性流軸封已建立基礎，部份機台及組件已技轉相關廠商，建議在此基礎下，配合國家科技發展政策，持續深化半導體製程設備核心技術開發，並評估我國在平面顯示器製程設備適宜發展之項目，重點建案投入開發。

二. 新興高科技產業發展中，能參與全球標準及規格之制定已成為一項重要策略工，我國在半導體與顯示器製程設備之研發作為上，有關標準及規格之掌握誠為重要，建議本院在投入相關技術研發工作的同時，能結合我國半導體產業協會（TSIA）及 TFT-LCD 產業協會（TTLA）共同參與全球在這兩大產業製程設備之標準及規格製定工作。

三. 我國顯示器生產大廠，為改善傳統以鑽石刀切割玻璃基板之缺點，正積極評估以雷射切割玻璃之製程技術，有鑑於雷射切割之優越性及發展潛力，而且該項技術仍處萌芽期，此項研發項目建議可由本院主導，並結合使用廠商，設備廠向經濟部建案以科專計畫重點投入研發。

四. 雷射加工機在半導體及顯示器製程中，如基材切割、標

誌、缺陷修補，快速退火，及微機電系統（MEMS）之製程如微加工技術等，將是重要製程設備，建議本院可逐步建立雷射加工應用之研究。

五. 建議本院與國際先進之研究機構策略聯盟,如 LZH e.v 公司的先進雷射技術開發，共同合作研究，以縮短國內研發時間，而能快速建立相關技術。

六. 本次在慕尼黑的半導體及材料展和漢諾威自動化展，均有專題演講，但受限行程緊湊，沒時間聽講，因 4 月 20 日到達慕尼黑會場已很晚，而歐洲從搭機及轉機幾乎浪費二天，若能提早一天到達，可多出時間找到適當專題多瞭解專家的最新訊息，建議類似展覽，歐洲出國天數限制能由 8 天調整回 10 天,多 1-2 天較有彈性安排行程，瞭解最新訊息會更多，作為研發的參考。

附　　　　　　　　　　　　　　　　　　　　　　　件

一、SEMI 協會展示期間研擬及修訂國際標準的相關資料

(1).Test,Assembly and Packaging Technical Committee meeting－－－ A1-A4

(2).MEMS Technical Committee meeting－－－－－－－－－－－－－－ A5-A8

(3).Equipment Automation Technical Committee meeting－－－－－－ A9-A13

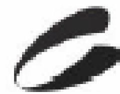
(4).Micro patterning Technical Committee meeting－－－－－－－－ A14-A16

(5).Silicon Wafer Technical Committee meeting－－－－－－－－－ A17-A22

(6).Compound Semiconductor Materials Technical Committee meeting－－－
－－－－－－－－－－－－－－－－－－－－－－－－－－－－－－－ A23-A25

(7).Joint meeting of the Gases and Liquid Chemicals Technical Committees
－－－－－－－－－－－－－－－－－－－－－－－－－－－－－ A26-A31

(8).Facilities Technical Committee meeting－－－－－－－－－－ A32-A34



SEMI International Standards Program

Test, Assembly and Packaging Technical Committee meeting

FMWG - Final Manufacturing Working Group

20 April in conjunction with SEMICON Europa 2004

Meeting Minutes

Attendees:

Andy Longford	PandA Europe	andy@pandaeurope.com
Luca Bernardini	Eles Semiconductor Equipment	Luca.bernardini@eles.com
Fabio Roverati	Eles Semiconductor Equipment	Fabio.roverati@eles.com
Hideaki Ogihara	HA	hiogiha@attglobal.net
Gernot Michaeler	Infineon Technologies	Gernot.michaeler@infineon.com
Bernd Ebersberger	Infineon Technologies	Bernd.ebersberger@infineon.com
Amir Roggel	Intel	Amir.roggel@intel.com
Paul Roddy	Motorola	Paul.roddy@motorola.com
Junko Washino	SEMI Japan	jwashino@semi.org
Paul Trio	SEMI North America	ptrio@semi.org
Elmar Cullmann	Suss MicroTec	e.cullmann@suss.de
Iain Gardner	Waferdata	Iain.gardner@waferdata.com

1.0 Welcome and Introductions

Andy Longford, PandA Europe, welcomed the participants. His area of expertise is more on the packaging side. Iain Gardner from Waferdata has experience on the Test side and had agreed to co-chair this meeting. A round of self-introductions was done.

Andy Longford made a short introduction to Standards and presented the legal anti-trust reminder (see attachment 1).

Paul Roddy was also representing the Semiconductor Test Council (www.semitest.org) a non-profit organization whose membership encompasses several of the key IC manufacturers, module and system vendors. The group was formed to develop a new Open Semiconductor Test Platform.

2.0 Status Report

Andy Longford made a status report (see attachment 2) of the European Final Manufacturing Working Group (Formerly Test, Assembly & Packaging (TAP) Committee). The current activities are:

- Working on setting up a TEST issues Liaison Working group (with STC).
- Working to form a Wafer Level Packaging working group (WLPG) … to look at potential standards issues
- Coordinating issues with MEMS packaging WG part of IMSG
- Planning for Autumn meeting (6-8 October)

The strategy is to set new topics specialized to Global needs (e.g. WLP, Flip Chip, Design for Test), create involvement of volunteers and evaluate (and eventually develop) the need for new standards. The proposal is to create various interest groups, select key issues, review needs for standards, change the way meetings are held (use sponsor locations) and ensure global support. Through this we hope this group can become the voice of the industry.
A copy of the minutes from the previous meeting held 30 October were distributed (see attachment 3). There were no questions and Andy moved to approve the minutes as written, no objections.

3. SEMI Standards Liaison Reports

Andy Longford reported that the activities in North America had stopped and the committee disbanded. Junko Washino from the SEMI Japan office presented a report of the Japanese activities (see attachment 4)

There was a question about the Strategy and Regulation for Environmental Issue announced by Sony. According to this since April 2003, Sony shall buy the piece parts and materials which are used for Sony Products only from Green Partners. No additional information was available at the time of the meeting but Junko Washino promised to make a report available together with these meeting minutes.

ACTION ITEM COMPLETED: Junko Washino to include with these meeting minutes a copy of the Green Procurement System implemented by Sony. See attachment 5 for a copy of the report.

4.0 Wafer level Packaging – Information Forum - Introduction

The purpose of the session is to involve all members of the Test and Assembly communities in Europe to consider the issues that will be forthcoming with the introduction of Wafer Level Packaging Technology. How will this affect Test, Assembly and packaging communities? Where will overlap issues cause difficulties and will introduction of "standards" help reduce costs of implementation? The Aim of the meeting is to investigate if and how SEMI standards can support

the development, offer solutions and become the voice of the industry in this new and emerging technology arena.

Andy Longford made a presentation (see attachment 6) to support the needs for standardization, identifying some WLP issues and future challenges for testing the packages.

5.0 Breakout groups – Packaging & Assembly and Test issues

The participants split in 2 groups to discuss what they perceived as hot issues. The groups reconvened and reported the following:

5.1 Comments from P&A

- Ball Pitch issues
  - Size standards
  - Rastor library
- Reliability
  - Current carrying capability...procedure TBD
- Licensing of technology types
- Lead free
- Failure Criteria
- Negative issues
  - Too many types of processes….licensed
  - Front end or Back end control

5.2 Comments from Test

- Wide range of issues
- Open bus architectures
- Cell controllers
- Test Data – applicable to all types of packages
- Die tracking
  - Traceability
  - Good bad die
- Bump before / after probe
  - Quality of bump to probe
- Background 300mm wafers – too thin?
- GPIB …> USB - bi-directional data control
- Burn in issues – Standardisation of equipments
- System in package (SiP) yield issues
- More data requirements needed STDF
- E107 spec should be reviewed
- Measurement of timing edge accuracy – G79, G80.
- OCR for wafer ID
- Micro wafer edge ID
- Access to test points

6.0 Any Other Business

6.1 Andy Longford brought-up the 2nd *International Conference on Lead-Free Electronics "Towards implementation of the RoHS Directive"* organized by IPC and Soldertec. The event is taking place June 22-23, 2004 in Amsterdam, The Netherlands.

6.2 Andy Longford reminded the existence of the *European Lead-free Network (ELFNET)*, which is now an EU sponsored project. Andy is the group leader representing the industrial partners.

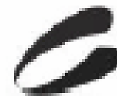
7.0 Adjourn

For the next meeting, it was suggested to run parallel sessions of Test and Packaging issues. Speaker s will be invited to address the issues brought up at this meeting.

Andy Longford thanked the participants for attending. The next European meeting will be held 6-8 October in Milan, Italy in conjunction with the SEMI Europe Standards autumn Conference and Meetings (with the support of STMicroelectronics) www.semi.org/eustandards2004

Minutes prepared by Paul Trio and Carlos Lee and approved by the committee co-chair Andy Longford.

Attachment available upon request, please email clee@semi.org



SEMI International Standards Program

MEMS Technical Committee meeting

20 April in conjunction with SEMICON Europa 2004

Meeting Minutes

Attendance:

Franz Schrank	Austria Micro Systems	Franz.schrank@austriamicrosystems.com
Bevan Wu	BW & Associates	bevanwu@stanfordalumni.org
Andres Lagos	Colibrys	Andres.lagos@colibrys.com
Helene Van Oost	Entegris	Helene_van_oost@entegris.com
Holger Walter	Entegris	Holger_walter@entegris.com
Jorgen Lundgren	Entegris	Jorgen_lundgren@entegris.com
Karl Kuehl	Fraunhofer IZM	Karl.kuehl@izm-m-fhg.de
Gordon Elger	Hymite	GEL@Hymite.com
Michael Freier	Innovative Robotics	mfreier@innovativerobotics.com
Jong-Oh Park	Intelligent Microsystems Center	jop@microsystem.re.kr
Robert Scace	Klaros Corp	scace@klaros.com
Mike Roughton	MGR Consultants / ENCAST Project Manager	Mike.roughton@lineone.net
Klaus Hoehn	NTK Tech. Ceramic	K_hoehn@ngkntk.de
Martin Walker	Oxford Instruments Plasma Technology	Martin.Walter@oxinst.co.uk
Carlos Lee	SEMI Europe	clee@semi.org
Bettina Weiss	SEMI HQ	bweiss@semi.org
Hiroko Saito	SEMI Japan	hsaito@semi.org
Robert Lee	SUMCO USA	Robert.Lee@Sumcousa.com
Gabi Fernholz	VDI/VDE -IT	fernholz@vdivde-it.de
Karlheinz Freywald	X-Fab	Karlheinz.freywald@xfab.com
John Davis		jjdavies@sonic.net

1.0 Welcome and Self-Introductions

Andrés Lagos opened the meeting and welcomed all participants. Self-introductions were made. Carlos Lee presented an overview of the SEMI Standards Program as well as the anti-trust reminder (see attachment 1).

2.0 Approval of the meeting minutes from 31 October 2003

The last committee meeting minutes were reviewed (see attachment 2). No additional comments were noted and the minutes were approved as written.

It was reported on the action items and comments made:

a) The NEXUS Packaging USC group has been found not to be interested in packaging standards for MEMS but, if work is carried out, they wish to be involved.

c) The German DIN standards organisation has produced a draft standard for MEMS wafer trays, it is to be established if this can be used to produce a SEMI standard for MEMS wafer trays.

d) It was commented that standards should be suggested and developed by the members and if there were no volunteers joining the task forces there would be no new standards.

e) It was also suggested that MEMS committees should work with existing committees and no dual work should be carried out.

The following action items was identified as open and carried foward for completion prior to the next meeting:

European task forces to complete a SNARF, Standards New Activity Report Form and TFOF, Task Force Organisation Form.

3.0 Committee scope review and charter approval

Carlos Lee said that the charter of the committee is "Work on unique requirements of Standards for MEMS devices that cannot be handled byexisting technical committees". The International MEMS Standards Committee was authorized by the ISC (International Standards Committee) in Munich, last April 2003.

4.0 Task Force reports – status update

4.1 Wafer Backside Exclusion Frame Size task force - Items under discussion are handling methods – vacuum paddles, mechanical grippers; standardized contact methods or contamination limits e.g. particles; exclusion zone size, width from edge, limits for wafer thickness and bow, exclusion on front side and double sided processed wafers, is it front/back side device dependant. Still more work with expert volunteers needs to be carried out and the production of a standard started.

4.2 Universal Alignment Targets for Wafer Bonding task force. Similar task force has been created in North America and it was agreed that both the European and North American taskforces would work closely together. The scope is to investigate and develop standards for design and use of on-wafer bonding targets, define dimensions, tolerances, locations and other attributes of on-wafer bonding targets employed in direct-wafer and other wafer bonding applications in MEMS manufacturing. NA TF contact is Winthrop Baylies (winba@comcast.net) and a SNARF (Standards New Activity Report Form) has been assigned document number 3951 – "Guide for Specifying On-Wafer Bonding Targets"

4.3 Terminology task force. Report by Gabi Fernholz: Gabi reported that, besides looking at existing standards on terminology including the draft IEC62258 and the IEC61360, they have also looked at the MANCEF roadmap glossary, the technical terms in the Japanese Micro-machining centre, which is on the web at www.mmc.or.jp , definitions used for the German national MST program and the SEMI compilation of terms International standard. However these all need to be studied in detail and rationalized. At the separate task meeting held on 21st April it was agreed that experts

were required to volunteer to carry out this work and contacts were required from the USA and Japan to help with the co-ordination of the task.

John Davis is heading the PIC (Physical Interfaces and Carriers) Maintenance Task Force. He said the TF is also looking at terminology because some terms have several definitions, some of which are valid, some of which are unnecessary. The MEMS Terminology TF is to liaise with the PIC Maintenance TF.

Robert Scace said that the North American MEMS Packaging and Fluidics task forces also have Terminology on the list of things to address.

4.4 MEMS Trays and Carriers task force. Report by Gabi Fernholz: It was reported that MEMS trays are very like photo mask trays and this should be used as a starting point. Tables of dimensions, hole spacing etc. should be produced for consideration to produce the standard. Jorgen Lundgren, Entegris will look into leading this activity further together with the current leader Josef Gentischer from company ACR.

There is also a general issue that DIN is not willing to transfer any of its standards to SEMI but rather deals directly with ISO. DIN does not recognize SEMI as a Standards Developing Organization.

5.0 Standards Activities in North America

Bob Scace reported that the MEMS standards activity in North America had co-committee chairs of Michael Huff, MEMS Exchange and Dan Chilcott, Delphi and vice chair Win Baylies, BayTech. They have had two meetings and several teleconferences since the committee was formed in 2003.

It was then reported that there were six tasks forces and working groups in the US which are:

a) MEMS Fluidics Interface TF
b) Wafer-bonding Target TF
c) MEMS Test WG
d) MEMS Packaging WG
e) Process Steps WG and
f) Wafer Specifications for MEMS Applications TF

Some of the work and targets of these task forces include: a) looking at I/O dimensions, spacing and flow and interaction with Packaging WG. Also using SI units as standard. b) Develop guidelines for specifying on-wafer bonding targets. c) Looking at wafer bond quality using various metrologies. d) Looking at hermeticity, marking, device reliability, external interconnects, assembly process quality measures, thermal specifications, packaging dimensions, etc. e) Focusing on micro-mechanical process recipes vs. results in one or more areas: etching, ion implant, eutectic bonding, low-stress nitrides and measurements. f) Have been looking at the MIT wafer bonding experiment and wish to produce a guide for specifying wafer geometry for direct-bonded applications.

A copy of the presentation is available as attachment 3.

6.0 MEMSTAND Roadmap distribution

Uwe Behringer reported that the MEMSTAND Standards roadmap had been completed and that copies were available. A soft copy can be downloaded from http://www.memstand.org

7.0 IEC 62258 Procurement Standard *presented by Mike Roughton*

IEC 62258 is an International standard being prepared by the IEC project team PT47/62258 and at present is in four main parts. Part 1 is entitled Requirements for procurement and use of semiconductor die products. This includes bare die, die with connection structures e.g. flip chip and minimally packaged die or wafers. Part 2 is Exchange data formats which is a means of communicating die information electronically. Part 3 is Recommendations for good practice in handling, packing and storage and Part 4 is a Customer/supplier questionnaire. Parts 1 and 2 should be published mid 2004, Part 3 early 2005 and Part 4 late 2005. We are also considering a part 5 on thermal and electrical simulation. The members of the project team come from UK, USA, Germany, Netherlands, Switzerland and Japan

A copy of the presentation is available as attachment 4.

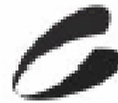
9.0 Adjournment

Andres Lagos thanked the participants for their participation and announced that the next meeting would be held in North America in conjunction with SEMICON West in July 2004 www.semi.org/semiconwest

The next European meeting would be held in conjunction with the SEMI Europe Standards autumn Conference and Meetings, 6-8 October in Milan, Italy with the support of STMicroelectronics. More information on www.semi.org/eustandards2004

Minutes prepared by Carlos Lee and approved by the committee co-chair Andrés Lagos

Attachment available upon request, please email clee@semi.org



SEMI International Standards Program

Equipment Automation Technical Committee meeting

20 April 2004 in conjunction with SEMICON Europa 2004

Minutes

Participants list

Alfred Honold	InReCon	Alfred.Honold@inrecon.de
Serge Brandolin	"Adixen" Alcatel Vacuum Technology	Serge.brandolin-ST@adixen.fr
Paul Gillot	"Adixen" Alcatel Vacuum Technology	Paul.gillot@adixen.fr
Michel Morin	"Adixen" Alcatel Vacuum Technology	Michel.morin@benoite-global.com
Takatsugu Yamasaki	Algo System	yamasaki@algosystem.co.jp
Nico Verhaar	ASM International	Nico.Verhaar@asm.com
Tom Hoogenboom	ASML	Tom.Hoogenboom@asml.com
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Helene Van Oost	Entegris	Helene_van_oost@entegris.com
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Georg Roeder	Fraunhofer IISB	Georg.roeder@iisb.fraunhofer.de
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Hideaki Ogihara	HA	hiogiha@attglobal.net
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Steve Fulton	ISMI	Steve.fulton@ismi.sematech.org
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Paul Trio	SEMI North America	ptrio@semi.org
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Artur Lederhofer	Siemens	Artur.lederhofer@siemens.com
John Davies	TD Systems	jdavies@sonic.net
Terry Asakawa	TEL	Terry.asakawa@tel.com
Frank Petzold	trustsec	Frank.Petzold@trustsec.de

Summary of action items:

- Carlos Lee to post updated Functional Safety TFOF on the website
- Artur Lederhofer to contact the Sensor Actuator Bus sub-committee in Japan under the Facilities committee and verify if they would like to have the ballot for E54.8 revision distributed to the Facilities committee in addition to the I&C committee.
- Artur Lederhofer to submit ballot for E54.8 revision to SEMI by July 22 for review at the European Autumn meetings.
- Artur Lederhofer to submit ballot 3714 to SEMI by July 22 for review at the European Autumn meetings.
- Carlos Lee to follow-up with Georg Roeder to receive a copy of ballot 3624 „New Standard: Guide for Specification Of Ellipsometer Equipment For Use In Integrated Metrology" by 22 July for review at the next European meeting.
- Carlos Lee to follow-up with Juergen Frickinger to receive a copy of ballot 3128B by 22 July for review at the next European meeting.

1.0 Welcome and Self-Introductions

Alfred Honold welcomed the participants and a round of self-introductions was done. He presented the agenda and showed a slide with the overall structure of the committee (see attachment 1).

2.0 SEMI Legal Reminders

Carlos Lee presented the anti-trust reminder (see attachment 2).

3.0 Review of the minutes from the last meeting

A copy of the meeting minutes were distributed (see attachment 3). Artur Lederhofer moved to approve the meeting minutes as written, Frank Petzold seconded the motion. 14 in favor. 0 opposed, motion passed.

Alfred Honold reviewed the action items. Action item 2 (TFOF for Functional Safety to be on the website) was identified as still open and carried forward for immediate completion.

4.0 Information & Control Subcommittee Report

Akhauri P. Kumar presented the report (see attachment 4) that included an update on the following task forces

- International Equipment Engineering TF
- OBEM (Object Based Equipment Model) TF
- DDA (Diagnostics Data Acquisition) TF
- RAP (Recipe and Parameter Management) TF
- XML (Extended Markup Language) TF
- PCS (Process Control Systems) TF

MOTION: With the successful transfer of the original tasks of the Equipment Integration TF to the IEE task force, Akhauri P. Kumar moved to sunset the Equipment Integration TF. Ogihara-san seconded the motion. 14 in favor, no objections, motion carried.

5.0 SANPro (Sensor Actuator Network Communication Standard for PROFInet) task force

Artur Lederhofer reported on the SANPro TF (see attachment 5).

MOTION: The SANPro TF has expanded its scope, in addition to developing doc 3714 (SANPRO – PROFINET) the task force will start working on revising E54.8 revision (SANPRO - PROFIBUS). Juergen Mitterer has submitted a new SNARF for the revision of SEMI E54.8 (see attachment 6). Artur Lederhofer moved to approve the new SNARF, Akhauri P. Kumar seconded the motion. Ogihara-san commented to check with the Sensor Actuator Bus sub-committee in Japan under the Facilities committee if they would like to have this ballot distributed to the Facilities committee in addition to the I&C committee. Ogihara-san recommended also to establish communication with the A-Link TF in Japan Facilities Committee. 13 in favor, no objections, motion carried.

ACTION ITEM: Artur Lederhofer to contact the Sensor Actuator Bus sub-committee in Japan under the Facilities committee and verify if they would like to have this ballot distributed to the Facilities committee in addition to the I&C committee.

MOTION: The SANPRO TFOF was revised (see attachment 7). Artur Lederhofer moved to approve the new TFOF, Philipp Dreiss seconded the motion, 12 in favor, no objections, motion carried.

MOTION: Artur Lederhofer moved for the distribution of a ballot to revise SEMI E54.8, Akhauri P. Kumar seconded the motion, 13 in favor, none opposed, motion carried.

ACTION ITEM: Artur Lederhofer to submit ballot for E54.8 revision to SEMI by July 22 for review at the European Autumn meetings.

MOTION: Send ballot for 3714. A. Lederhofer moved, Akhauri P. Kumar seconded the motion. 13 in favor, none opposed. Motion carries.

ACTION ITEM: Artur Lederhofer to submit ballot 3714 to SEMI by July 22 for review at the European Autumn meetings.

6.0 Other Task Force Reports

6.1 Integrated Measurement (Layer Thickness) TF presented by G. Roeder (see attachment 8).
ACTION ITEM: Carlos Lee to follow-up with Georg Roeder to receive a copy of ballot 3624 „New Standard: Guide for Specification Of Ellipsometer Equipment For Use In Integrated Metrology“ by 22 July for review at the next European meeting.

6.2 International Environmental Contamination Control TF presented by J. Frickinger (see attachment 9)

6.3 E103 Maintenance TF presented by M. Morin (see ballot review section 8.1 and attachment 19)

6.4 International PIC Maintenance TF presented by J. Davis (see attachment 11)

7.0 Liaison Reports

7.1 *Japanese I& CC liaison report* (see attachment 12) was presented by Alfred Honold.

7.2 *North American I&C liaison report* (see attachment 13) was presented by Lance Rist.

7.3 *Japanese Metrics liaison report* (see attachment 14) was presented by Miki Furukawa-san.

7.4 *North American Metrics liaison report* (see attachment 15) was presented by Alfred Honold.

7.5 *Japanese Physical Interfaces and Carriers (PIC) liaison report* (see attachment 16) was presented by Koji Ohyama-san.

7.6 *North American Physical Interfaces and Carriers (PIC) liaison report* (see attachment 17) was presented by Alfred Honold.

8.0 Technical ballot review

8.1 3889 *Revision to SEMI E103, Provisional Mechanical Specification For A 300 MM Single-Wafer Box System That Emulates A FOUP* (see attachment 18)

Alfred Honold presented the tally. Document 3889 reached the required return rate and received 1 comment related to Line Item 1&2 and 1 reject to Line Item 2. Michel Morin reviewed the reject from Intel:

"If info pad B is no longer required to be in the down position, the whole sentence should be removed since this now becomes a redundant requirement with the first sentence in section 6.2 (formerly 5.2)."

Arguments from the task force:

- The 1st and 2nd sentences are not redundant. The 1st sentence is a general statement about the requirements for SWIF to meet all FOUP dimensions.
- The 2nd sentence specifies the "Configure-ability" requirement of pads by referring to section 6.12 of E47.1.
- The "configure-ability" is not found in the first sentence.
- The "configure-ability" requirement is of critical importance for the design, the manufacturing and the tool integration of FOUPs and particularly SWIF system.

MOTION: Michel Morin moved to find the reject of Intel related but technically non-related, Jorgen Lundgren seconded the motion. There was no discussion. 6 in favor, no objections, the motion carried.

The comments from Larry Hartsough, U.A. Associated were reviewed but the task force decided not to further modify the document.

Comments:

- The reference to the section # (6.12) in E47.1 should be deleted, as it adds to the difficulty in maintaining E103.
- Line items 1 & 2 are really one LI.

Task force response:

- The comment raises up a general document maintenance issue that is resolved through PIP revision process, no ballot.
- The line item 1 and 2 have been created to reflect the mother E47.1 document architecture, i.e. the corresponding E47.1 sections 5.4 and 6.12 respectively.

MOTION: Michel Morin moved to send the document (3 Line Items) as it is to the ERSC for procedural review, Jorgen Lundgren seconded the motion. There was no discussion. 7 in favor, no objections, the motion carried.

MOTION: Michel Morin moved to sunset the E103 Maintenance TF. Jorgen Lundgren seconded the motion. There was no discussion. 11 in favor, no objections, the motion carried.

Task force report available under attachment 19.

8.2 3128A Test Method for the Determination of Particulate Contamination from Minienvironments

Alfred Honold presented the tally (see attachment 20). Document 3128A reached the required return rate and received 1 comment and 3 rejects. Juergen Frickinger

commented that the task force had found at least one reject to be technically persuasive. Juergen reviewed comment #4 of David Bouldin referring to the formula in section 11.4.2.1 & 11.4.2.2.

MOTION: Juergen Frickinger moved to find the reject #4 from David Bouldin related and technically persuasive. Lance Rist seconded the motion. 9 in favor, no objections, motion carried.

MOTION: Juergen Frickinger moved to send a reworked ballot for review at the next meeting. Hideaki Ogihara seconded the motion. 9 in favor, no objections, motion carried.

ACTION ITEM: Carlos Lee to follow-up with Juergen Frickinger to receive a copy of ballot 3128B by 22 July for review at the next European meeting.

9.0 Adjourn

Alfred Honold thanked the participants for their participation. The next European meeting is scheduled for 6-8 October in Agrate, Italy in conjunction with the SEMI Europe Standards autumn Conference and Meetings.

Minutes prepared by Carlos Lee and approved by the committee co-chair Alfred Honold.

Attachment available upon request, please email clee@semi.org

SEMI® International Standards

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SEMI International Standards Program

Micropatterning Technical Committee meeting

20 April in conjunction with SEMICON Europa 2004

Meeting Minutes

Attendees:

Patrick Martin	Photronics	pmartin@dallas.photronics.com
Jacques Waelpoel	ASML	Jacques.Waelpoel@asml.com
Karl Sommer	KSC	Karl-sommer@t-online.de
Richard Eandi	Zygo Corp.	reandi@zygo.com
Brid Connolly	DPI	Brid.Connolly@photomask.com
Werner Mirande	PTB	Werner.mirande@ptb.de
Uwe Behringer	UBC Microelectronics	Uwe.Behringer.ubc@t-online.de
Henning Haffner	Infineon Technologies	Henning.Haffner@infineon.com
Fons Marijnissen	Photronics	fmarijnissen@eu.photronics.com
John Smith	Photronics	jgsmith@uk.photronics.com
Paul Trio	SEMI North America	ptrio@semi.org

1.0 Welcome

Jacques Waelpoel welcomed the attendees and a round of self-introductions was done.

2.0 Overview of the SEMI Standards program

Paul Trio made a short overview presentation of the SEMI International Standards Program and presented the legal anti-trust reminder (see attachment 2).

3.0 Europe Micropatterning Committee Charter

Paul Trio informed the committee that a charter must be established for the Europe Micropatterning committee. Paul Trio then presented the North America Microlithography Committee charter and asked the committee to make any changes that will better describe the purpose and objectives of the European region. In the absence of any further amendments, a motion was made to approve the charter. The vote was unanimous in favor. A copy of the Europe Micropatterning Committee charter is available under attachment 3.

> Charter: To explore, evaluate and formulate consensus-based micropatterning specifications that through voluntary compliance will enhance the manufacturing capability of the semiconductor industry.

Scope: The committee will investigate the development of standards in photomask materials, dimensions, reliability and quality. This includes standard patterns and procedures for critical dimensions (CD) and overlay measurement, and assessment of lithographic chemical purity as they are related to photomask manufacturing and wafer exposure by lithography.

4.0 Review of the minutes from the last meeting

A copy of the minutes from the previous meeting held 30 October was distributed (see attachment 4). Rik Jonckheere was not present to address inquiries about the Terminology for Photomask Fabrication and Qualifications Task Force activities. Jacques Waelpoel stated that the task force is currently examining issues on dry etching and recommends holding 2-3 sessions to discuss this topic as well other objectives. Teleconferencing and online-meeting tools (such as WebEx or SameTime) were proposed.

ACTION ITEM: Carlos Lee and/or Patrick Martin (Photronics) to provide more information on how to use WebEx or SameTime.

With no further discussions, Jacques Waelpoel moved to approve the minutes as written. No objections, minutes approved.

5.0 Liaison Reports

5.1 The North America liaison report was presented by Paul Trio (see attachment 5).
5.2 The Japan liaison report was presented by Uwe Behringer (see attachment 6).

6.0 Task Force report

6.1 Definition of Specifications (Terminology) for Photomask Fabrication and Qualification Task Force – a report was by Jacques Waelpoel on the outcome of the meeting held the previous day.

6.2 Definition/Standardization of Photomask-Flatness - a report was made by Richard Eandi and he presented the update from the PhotoMask Japan held earlier in the month and Munich meeting held earlier prior to this meeting. A copy of the report is available as attachment 7.

The bottom line is that there is presently no apparent penalty resulting from reticle non-flatness being incurred by anyone in the semiconductor device manufacturing chain. Until someone feels some pain and there is industry consensus that reticle flatness tolerances of finished masks before and after pellicization need to be defined and enforced, there is little justification to continue a task force to develop a standard that nobody feels they need.

Richard will continue to pulse device makers and mask makers to ascertain if they anticipate flatness concerns at the 45nm and 32nm technical nodes. This TF may just need to be delayed, rather than abolished, until there is a demonstrated need to define finished mask flatness tolerances and members put a sufficient priority level on this task to devote their time to help. If Richard receives some support to continue this activity, he

will entertain scheduling a third Photomask Flatness TF to be held during the EMC (European Mask Conference) 2005 in January, or SPIE Microlithography in February 2005, to explore what, if anything, should be done. In the meantime, any feedback on this issue is appreciated.

Japan suggested to create a working group rather than a task force to further explore the idea.

7.0 Invited presentation

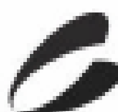
Patrick Martin, Photronics, made a presentation on "Developing Standards for Advanced Photomask Applications". A copy is available under attachment 8.

8.0 Adjourn

The committee co-chairs thanked the participants for attending. The next European meeting will be held 6-8 October in Milan, Italy, in conjunction with the SEMI Europe Standards Autumn Conference and Meetings (with the support of STMicroelectronics). More information on www.semi.org/eustandards2004

Minutes prepared by Paul Trio and Carlos Lee and approved by the committee co-chairs.

Attachment available upon request, please email clee@semi.org



SEMI International Standards Program

Silicon Wafer Technical Committee meeting

21 April 2004 in conjunction with SEMICON Europa 2004

Meeting Minutes

Participants:

John Valley	ADE	jolo@ade.com
Noel Poduje	ADE	noelp@ade.com
Tetsuo Fukuda	Fujitsu	Fukuda.tetsu-01@jp.fujitsu.com
Rob Harper	IQE	RHarper@IQESilicon.com
Werner Bergholz	IUB	w.Bergholz@iu-bremen.de
Robert Scace	Klaros	scace@klaros.com
George Kren	KLA-Tencor	George.kren@kla-tencor.com
Yasuhide Nakai	Kobelco	nakai@leonet.kobelco.co.jp
Maurizio Migliorini	MEMC	mmigliorini@memc.it
Bill Hughes	MEMC	bhughes@memc.com
J. V. Martinez de Pinillos	NIST	Jack.martinez@nist.gov
Satoshi Akiyama	Roytex	sakiyama@roytex.com
Carlos Lee	SEMI Europe	clee@semi.org
Erich Krammer	SEZ	e.krammer@at.sez.com
Peter Wager	Siltronic	Peter.wagner@siltronic.com
Hiro Takeuchi	SUMCO	hirotake@sumcosi.com
Robert Lee	SUMCO USA	Robert.Lee@sumcousa.com

1.0 Welcome and Self-Introductions

Werner Bergholz, co-chair of the Silicon Wafer Standards technical committee in Europe, welcomed the participants and a round of self-introductions was done.

2.0 Legal reminders

Carlos Lee presented the Antitrust reminder (see attachment 1).

3.0 Previous meeting minutes

A copy of the minutes from the previous meeting held 30 October in Nijmegen were distributed and Werner Bergholz commented on the open action items (see attachment 2). Peter Wagner moved to approve the meeting minutes as written. Jack Martinez seconded the motion. Unanimously approved, motion carried.

In response to one of the action items, Werner Bergholz updated the attached Si Roadmap:

Topic	*Issue*	*Priority*	*Urgency*	*Comment*
300 mm Wafer	Laser mark after reclaim	High	Yes	New
	Secondary packaging box	High	Yes	New
Novel Si-based Wafers	Silicon strained layer wafers	High	YES	New
	Anything on Silicon ???	High	YES	New
	SOI	High	Yes	Ongoing
	450 mm wafer	Low	No	New
Critical Wafer Specifications	Wafer edge characterization • Profile • Roughness • Defects	High	Yes	Ongoing Proposed classification of edge defects (chipping, crack, hidden lattice damage/strain, etc.)
	0.1 µm generation technology and beyond: metrology requirements for Si wafers	High	Yes	New Proposed SEMI Europe workshop
Particle removal efficiency test	➢ Initiated by Martin Knotter, Philips ➢ Not a match with the Si wafer committee, to be referred to Cleaning equipment makers	?	yes	New
Front wafer mark to be put on a wafer at the end of the front end process	➢ Initiated by ST ➢ Passed on to the traceability committee ➢ ST should take task force leader ship	high	yes	New

4.0 Liaison reports

4.1 The *North America liaison report* was presented by Noel Poduje, North America Silicon Wafer committee co-chair (see attachment 3).

4.2 The *Japan liaison report* was presented by Hiro Takeuchi, Japan Silicon Wafer committee co-chair (see attachment 4).

5. Task Force report

5.1 *International Advanced Wafer Geometry Standards Task Force* reported by Peter Wagner (see attachment 5). Discussion on a proposal from SEMI Japan and JEITA on ERO. Proposal by Paul Langer about re-activation of efforts for a new Nanotopography standard. Review of ballot 3835A. Several presentations made at the task force meeting, please contact peter.wagner@siltronic.de for a copy.

5.2 International AWSIS (Automated Wafer Surface Inspection Specification) Standards Task Force by George Kren. Previous meeting in March in La Jolla. Minutes were reviewed and discussion on SEMI M50. Discussion is carried forward for the next meeting in July. Discussed the PRE issue originally raised by Martin Knotter, New business: M52 will be updated and a draft should be available for July.

5.3 *General Silicon Wafer Specifications Standards Task Force* was verbally reported by Bob Lee. A new draft of SEMI M1 was presented at the 19 April meeting. The document should be completed after July. Numerous teleconferences among North America and Japan. Would appreciate more participation from Europe. Werner Bergholz has informed and encouraged Infineon Technologies to get involved. Philips should also be approached.

5.4 International Basic Silicon Wafer Specification Standards Task Force was reported by Bill Hughes (see attachment 6). TF sunset. New business will be handled either by the General Wafer TF or the Prime Silicon Wafer Sub-committee.

MOTION: Bill Hughes moved to disband the International Basic Silicon Wafer Specification Standards Task Force. Hiro Takeuchi seconded the motion, all in favor, motion passed.

5.5 *Particle Removal Efficiency*

Peter Wagner informed Martin Knotter mid-January that the subject of generating a standard regarding cleaning efficiency was again discussed at the meeting of the AWSIS TF in Japan in December. The AWSIS TF thinks that the best way to proceed would be for Martin to start a new TF or some other person interested. Peter Wagner would support Martin in setting up a task force and getting it started as well as to contribute knowledge about particle measurement. Bother Peter Wagner and Martin Knotter have contacts at IMEC of people involved in wafer cleaning research, and maybe they are willing to cooperate. Murray Bullis informed Carlos Lee that he believes that the document 3592, which was approved in March 2004 in La Jolla, provides a good basis for characterizing deposits of any material even though it is directed to PSL spheres because it is intended to support SSIS calibration as defined in SEMI M52 and SEMI M53. There was no interest among the members present in La Jolla to work on this project, but they would certainly encourage the members of the European Silicon Wafer Committee to carry it out and when the time comes we would be happy to help make sure the document they prepare is in good form for balloting.

5.6 *Wafer Front Surface Marking of a User Traceability Code*

Murray Bullis informed Carlos Lee that the original marking document (SEMI M13) originally included a user field which was subsequently eliminated because there was no interest back then in the user community to standardize the location of the

user-applied mark. So in the present case, he would encourage the proponents to assure that at least three to five companies would be interested in the same type of mark before investing any significant amount of effort in generating the document. There was no interest among attendees at La Jolla to work on the document itself, but if there is sufficient interest in the user community, such a document could easily be accepted. Hiro Takeuchi reported that the Japanese Traceability has issued a yellow ballot 3623A to revise SEMI T7.

ACTION ITEM: Carlos Lee to send to Antonio Do Bento Vieira a copy of the ballot and inform him of the current status.

6.0 Ballot review - Doc. 3835A - Revision of SEMI M49-0303 Guide for Specifying Geometry Measurement Equipment for Silicon Wafers for 130 nm Technology Generation

Peter Wagner presented the tally that reached the 60% return rate. The document received 2 comments and 2 rejects. The TF ballot review report is available as attachment 7. Ballot 3835A is available as attachment 8.

Reject from Naoyoshi Tamura, Fujitsu

Reject: "The site size of local flatness on table 3 is different from one on Table 6."

While in the table referring to the scaling models it mentions 25 * 8 mm^2 instead of 26 * 8 mm^2 as it was suppose to be repeated in the specification.

Naoyoshi Tamura emailed Peter Wagner on 13 April that he will withdraw his submitted reject vote if the difference was caused by editorial mistakes. Peter Wagner confirmed that the mistake was caused by an editorial mistake and informed N. Tamura that the difference is unintentional.

Bob Scace moved to accept as editorial change the correction in the appendix Table A1-1 section 1.4 changing the number "25 * 8 mm^2" to "26 * 8 mm^2", George Kren seconded the motion, 11 in favor, no objections, no abstentions. Motion passed.

Reject from Noel Poduje, ADE

Reject: "Table 3, Section 4.3.1 requires a test interval for Level 3 variability of 2 weeks minimum. This is not practical in a commercial environment. Although we recognize the intent of the Level 3 test and also that the document is "a guide, not a specification", we feel that including such a requirement creates a serious burden for an equipment maker. Many of our customers are likely to quote the document in specifying equipment, compelling us to test each system for at least two weeks to show compliance.

ADE suggests retaining the present published wording, "user specific" and "to be recommended by supplier of measurement equipment". If it is thought necessary to explicitly state the two week period, words can be crafted which include this concept while making it clear that every system need not be tested this way. ADE will work with the AWG Task Force to develop a suitable modification to the document".

Peter Wagner suggested addressing the reject by adding the following note in section 4.3.1 after "...not less than 2 weeks":

"This recommended specification is not intended to be a requirement for a two week pre-shipment test. Performance could be verified through routine SPC (Statistical Process Control)."

Bob Scace moved to consider addition of the above note as an editorial change. Bob Lee seconded the motion. 10 in Favor, no objections, 1 abstention. Motion passed.

Noel Poduje withdrew his reject on document 3835A.

In response to the comments received, Bob Scace moved to accept the 2 comments as editorial and be accepted for incorporation in the final version of the document, Bob Lee seconded the motion, all in favor, motion passed.

Summary of the editorial changes

1) In the appendix Table A1-1 section 1.4 change the number "25 * 8 mm^2" to "26 * 8 mm^2"

2) Remove text "NOTE 1:" under 2.1

3) In 2.1.3.3 change "145" to "14"

4) In 4.3.1 add after "... not less than 2 weeks" a Note with text "This recommended specification is not intended to be a requirement for a two week pre-shipment test. Performance could be verified through routine SPC (Statistical Process Control)."

Bob Lee moved that this document is not a Safety Document. Bob Scace seconded the motion. 11 in favor, no objections, no abstentions. Motion passed.

Jack Martinez moved to send the document to ERSC for Procedural Review. Peter Wagner seconded the motion, 11 in favor, no objections, no abstentions. Motion passed.

A copy of the document with the incorporated changes is available as attachment 9.

7.0 New Standardization Issues

Peter Wagner presented (see attachment 10) standardization challenges and opportunities based on the presentations made at the Silicon Wafer Standards workshop held 20 April 2004. Opportunities for standardization were identified in the areas of Edge Roll-Off, Edge Profile, Edge Inspection, Wafers with Functional Layers and Integrated metrology & Inspection.

ACTION ITEM COMPLETED: Werner Bergholz to report to the other committees at the ERSC meeting on 22 April that there are complex standardization requirements resulting form integrated inspection and metrology.

8.0 Standards requirements for Strained Silicon

Rob Harper, IQE, showed again his presentation (see attachment 11) from the previous day and highlighted the opportunities for standardization in the area of Strained Silicon.

Followed a discussion on the presentation and the following next steps recommended: Rob was advised to contact Hiro Takeuchi, Japan Silicon Wafer committee co-chair and identify what activities already exist in Japan related to Strained Si. Japan is strongly interested in this topic. Prioritize the topics that need to be addressed first. If appropriate, created a task force.

Bull Hughes reported that a Schimmel Edge Standard already exists and could be used as a basis.

9.0 Adjourn

Werner Bergholz thanked the participants for attending. The next European meeting will be held 6-8 October, Agrate, Milan in conjunction with the SEMI Europe Standards autumn Conference and Meetings (with the support of STMicroelectronics)

Minutes prepared by Carlos Lee and approved by the committee co-chair Werner Bergholz. Attachment available upon request, please email clee@semi.org

List of attachments:

1. Anti-trust reminder
2. Minutes from the 30 October meeting
3. North America liaison report
4. Japan liaison report
5. *International Advanced Wafer Geometry Standards Task Force* report
6. International Basic Silicon Wafer Specification Standards Task Force report
7. 3835A ballot report from the task force
8. Ballot 3835A
9. Ballot 3835A with the editorial changes
10. Standardization opportunities report based on the workshop presentations
11. Presentation on Strained Silicon standardization opportunities

SEMI International Standards Program

Compound Semiconductor Materials Technical Committee meeting

21 April 2004 in conjunction with SEMICON Europa 2004

Meeting Minutes

Attendees

Roy Blunt	IQE (Europe)	rblunt@iqep.com
Petra Feichtinger	Bede Scientific Inc	Petra.feichtinger@bede.com
Tamzin Lafford	Bede Scientific Instruments	Tamzin.Lafford@bede.co.uk
Heiko Ress	Bruker AXS	Heiko.ress@bruker_axs.de
Ute Zeimer	FBM Berlin	Zeimer@fbh-berlin.de
Roland Bindemann	FCM	Bindemann@fcm-germany.com
Hans Christian Alt	FHM	hchalt@fhm.edu
Nikolaus Herres	NTB Buchs	herres@gmxpro.de
Carlos Lee	SEMI Europe	clee@semi.org
Wolfgang Jantz	SemiMap	Wolfgang.Jantz@semimap.de
Arnd Weber	SiCrystal	Arnd.weber@sicrystal.de

1.0 Welcome and Self-Introductions

Roy Blunt welcomed the participants and a round of self-introductions was done.

2.0 SEMI Standards Legal Reminders

Carlos Lee presented the antitrust-reminder (see attachment 1).

3.0 Review of the minutes from the last meeting

A copy of the minutes from the previous meeting held 30 October in Nijmegen were distributed (see attachment 2). The minutes were unanimously approved and all action items completed.

4.0 Liaison reports

4.1 The North America liaison report was presented by Roland Bindemann (see attachment 3). Wolfgang Jantz is following up with the SiC activities at ASTM. The ASTM task force has not contacted Arnd Weber so far.

4.2 The Japan liaison report was presented by Roy Blunt (see attachment 4)

5.0 Task Force reports

- *Epitaxial Wafer Evaluation (ECV- Electrochemical Capacitance Voltage)* TF report was presented by Roy Blunt (see attachment 5). The TF feels that it is not going to get any further along the path of providing standard reference ECV profiling materials as part of a SEMI TF. If it is going to happen it will have to be (under current circumstances) a commercial arrangement. The TF will reform to handle any revisions/maintenance to the existing ECV profiling standard as required. The task force is disbanded.
- *Epitaxial Wafer Evaluation (XRD- X-ray diffraction) TF* report was presented by Roy Blunt (see attachment 5). Good progress. 2 pre-release samples of AlGaAs on GaAs reference samples from NIST plus 2 AlAs samples from FBH have been circulated for XRD measurement by the TF. Results showed good agreement on peaksplitting measurements between participants. The guideline procedure is now being drafted. Aiming at blue ballot by September 2004 so the feedback may be discussed at the next committee meeting.
- *GaSb Wafer Specification Global Task Force* report was presented by Roy Blunt (see attachment 5). Apologies from Ian Grant for not being able to attend this meeting. First draft specification about to be circulated, business mainly conducted via e-mail.
- *SI GaAs Material Parameter Specification Global TF* report was presented by Wolfgang Jantz. The task force is disbanded.
- *200mm GaAs Global Task Force* report presented by Roland Bindemann. The kick-off meeting was started today. The SNARF was approved by GCS previously by Roy Blunt, Roland Bindemann, James Oliver, Koji Iwasaki, Russ Kremer. This will be a global task force (see attachment 6). Aim is to achieve a blue ballot around December and a yellow ballot by May 2005. Report and presentation on 200mm GaAs standards issues available as attachment 7.
- ***ACTION ITEM****: Carlos Lee to send the 200mmGaAs TFOF to GCS for approval so that it becomes a global TF.*
- SiC Task Force report presented by Arnd Weber (see attachment 8) including deadlines for 3" and 4" ballots.

6.0 Invited presentation

SiC Technology and Applications – an overview presented by Dr. Arnd-Dietrich Weber and available as attachment 8. The content of the presentation included:

- Material Properties of Silicon Carbide
- Applications
- Technology of Substrate Manufacturing
- Technology of Device Manufacturing

7.0 Survey on use of 150 mm GaAs SEMI Standard usage

Wolfgang Jantz reported that he is still working with the companies surveyed to increase the response return rate. Update at the next meeting.

8.0 DIN Standards discussion

Wolfgang Jantz reported on the meeting held prior to the committee meeting (see attachment 10). There are 17 DIN Standards published and there is an issue with the maintenance of these standards now that the DIN committee that created these standards has been disbanded. DIN has refused the transfer of the DIN Standards to SEMI. 5 of the 17 standards are under revision and these draft documents are not copyright protected. 1 document is in preparation and not copyright protected. All other documents were re-approved by DIN till 2008.

NEW TF: There is an unfinished project of a standard test method to measure the EL2 concentration in GaAs that is well under way, but never has been and never will be a DIN standard. It was agreed that Hans-Christian Alt would lead a task force to complete this standard under the SEMI framework.

NEW TF: There is another project on Crystal Orientation that can be taken over. It was agreed that Nikolaus Herres would lead a task force to complete this standard under the SEMI framework.

9.0 Adjourn

Roy Blunt thanked the participants for attending. The next European meeting will be held 6-8 October, Agrate, Milan In conjunction with the SEMI Europe Standards autumn Conference and Meetings (with the support of STMicroelectronics). More information on www.semi.org/eustandards2004

Minutes prepared by Carlos Lee and approved by the committee co-chairs Roy Blunt and Roland Bindemann.

Attachment available upon request, please email clee@semi.org

SEMI® International Standards

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Semiconductor Equipment and Materials International

SEMI International Standards Program

Joint meeting of the Gases and Liquid Chemicals Technical Committees

21 April in conjunction with SEMICON Europa 2004

Meeting Minutes

Attendance:

Gordon Ferrier	Air Products	ferrieg@airproducts.com
Dirk Hobrack	Air Liquide	Dirk.hobrack@airliquide.com
Marion Bolkenius	Air Liquide	Marion.bolkenius@airliquide.com
Reiner Taege	Air Products	taeger@apci.com
Torsten Fahr	AMD	Torsten.fahr@amd.com
Juergen Lerche	AMD Saxony	Juergen.lerche@amd.com
Gummaar De Vos	Arch Chemicals	gdevos@archchemicals.com
Dieter Gutwerk	Berghof Products + Instruments	Dieter.Gutwerk@berghof.com
Wolfgang Sievert	Honeywell	Wolfgang.Sievert@honeywell.com
Uwe Loyall	Metrohm	UL@metrohm.com
Jack Martinez	NIST	Jack.martinez@nist.gov
Jochen Ruth	Pall	Jochn_ruth@pall.com
Barrie Masters	Rockwood Materials	Barnie.masters@rockemat.com
Marco Succi	SAES Getters	Marco_Succi@saes-group.com
Yukari Takeyama	SEMI Japan	ytakayama@semi.org
Jean-Marie Collard	Solvay	Jean-marie.collard@solvay.com
Michael Pittroff	Solvay Fluor	Michael.Pittroff@solvay.com
Michael Sell	Solvay Interox	Michael.Sell@solvay.com
Matthias Dabrunz	Solvay Interox	Matthias.dabrunz@solvay.com
Harald Strynar	Texas Instruments	h-strynar1@ti.com
Wen-Bin Yan	Tiger Optics	wbyan@tigeroptics.com

1.0 Welcome and Self-Introductions

Jean-Marie Collard opened the joint European Gases & Liquid Chemicals Committee meeting and welcomed all participants. Self-introductions were made. Bettina Weiss presented an overview of the SEMI Standards Program as well as the anti-trust reminder (see attachment 1).

2.0 Review of the minutes from the last meeting

The last committee meeting minutes were reviewed (see attachment 2). No additional comments were noted.

One open action item: particulates in chemicals – W. Sievert. Since Wolfgang was not present at the time, this action item will remain open since more discussion is needed. Gordon Ferrier moved, Barry Masters seconded to approve the minutes as written. All in favor. Motion carried.

3.0 Liaison reports:

3.1 - North American Liquid Chemicals Committee and North American Gases Committee – presented by Jean-Marie Collard (see attachment 3) and Gordon Ferrier (see attachment 4).

- **ACTION ITEM**: Doc. #3433A New Standard: Specification For Port Configuration Of Canisters To Contain Liquid CVD Precursors : Wolfgang Sievert and Carlos Lee to bring this to Tim Leedham's attention.

3.2 - Japan Liquid Chemicals Committee and Japan Gases and Facilities Committee presented by Yukari Takeyama, SEMI Japan (attachments 5 & 6)

4.0 Task Force reports

4.1 Dichlorosilane TF – reported by Gordon Ferrier on behalf of Michael Schieferstein who apologized for being unable to attend. The German part of Messer Griesheim has been sold to Air Liquide. Michael Schieferstein due to a redefinition of his job function is no longer involved in electronic gases business and unable to lead this task force. The DIN committee has not finalized the proposed DIN-Standard concerning the analytical procedures for metals and dopants in DCS. Inconsistencies in the experimental data gained in a round robin required further investigations in Messer laboratories. With the current situation Messer is not willing to invest time or money in this. The TF considers disbanding this activity, a final decision is to be made at next committee meeting. In the mean time, Dieter Gutwerk to make a decision about taking over TF leadership.

4.2 Update on possible TF on precursors specifications – Jean-Marie Collard reported on behalf of Tim Leedham, Epichem. Clear specifications on precursors are needed despite divided opinions in the industry. Tim was able to convince enough people to start a task force. Members now will complete a SNARF and submit to Carlos Lee. First meeting is scheduled in conjunction with the European Autumn Meetings in Agrate, Italy. In the meantime, Tim will research the issue and come prepared with more data.

NOTE: In the meantime, a SNARF and TFOF have been prepared. They are available as attachments 7 & 8.

4.3 Gordon Ferrier reported that Kevin Cleaver, BOC Edwards, will step down as committee co-chair due to change of business focus. Kevin Cleaver has co-chaired the European Gases committee for 10 years. A *Honor Award* plaque will be handed over to him for his long-term contribution to this committee.

4.4 Revision to SEMI C28 (HF) Task Force

Jean-Marie Collard, Solvay, went over the final ballot results to be covered in the next agenda item. First part of the Task Force work is now being completed (clean up of current spec + addition of a Tier C Guidelines). The

second part of the task force work will lead to a second revision addressing analytical validation for the two guidelines. The task force is working hard to completing the task and members are working hard on getting full data. In order for an analytical methodology to be approved, it has to comply with requirements stipulated in SEMI C1 first.

5.0 Ballot review

Jean-Marie Collard presented the final tallies (see attachment 9).

5.1 Doc. #3692 – Revision to SEMI C28 Specifications and Guidelines for Hydrofluoric Acid (see attachment 10)

Kirsten Hanley, Intersil Corp, had voted Accept but commented that:

9.2.1.1: remove the hyphen in hydro(-)fluoric
13.6.3: remove the hyphen in environ(-)ment

All above changes are editorial. Motion to pass document with editorial changes and submit as stated to ERSC for procedural review : Wolfgang Sievert, seconded by: Gordon Ferrier. No rejections, no abstentions. Motion carried unanimously.

Safety check: Wolfgang Sievert stated that there was nothing in this document that could be considered a safety issue. Concentrations and constituents of the chemical compositions were not changed.

5.2 Doc. #3693 – Revision to SEMI C53 Specifications for Dimethyl Sulfoxide (DMSO) Grades 1 and 2 (see attachment 11).

Jean-Marie Collard, Solvay, had voted 'Accept' but commented that in table 1, unit for Acidity must be "meq/g", not "microeq/g", in accordance with paragraph 8.4.

The committee considered this to be an editorial change as "microeq/g" was an obvious error. The unit needs to be changed to be in alignment with the text.

Robert Henry, Thermo Elemental, voted 'Abstain' but commented that the list of elements specified is less than the 21 elements listed for other liquid chemicals.

The committee stated that all 21 elements were indeed there.

Summary of editorial changes;

Table 1, unit for Acidity must be "meq/g", not "microeq/g",

Motion: Gordon Ferrier, Jochen Roth seconded to pass Doc. #3692 with editorial changes and submit it to the ERSC for procedural review. No rejections, no abstentions. Motion carried unanimously.

Safety check: Committee members noted that no major components in the document were changed and that there were no safety related issues.

6.0 Technical presentations

6.1. Trace Analysis with Voltammetry presented by Uwe Loyall, Metrohm AG (see attachment 12)

Total metal concentration and analysis of metal species – an alternative to Spectroscopic Techniques? Voltammetry or polarography is an electrochemical analysis technique measuring the electrical current induced by the reduction or oxidation of an analyte on a small working electrode. This technique can be used for the analysis of trace metallic impurities within a number of matrices with sensitivities comparable to that of an AAS or ICP yet with a purchase price significantly lower than these instruments. The only requirement apart from small amounts of reagents is a source of high purity nitrogen and there is no need for expensive flammable gases, specially constructed fume hoods or costly metal vapour lamps. Detection limits are typically in the ppt range and concentrations are determined with standard additions that are carried out in each sample. This eliminates matrix effects and offers improved reliability. In addition, when compared to spectroscopic methods which can only determine the total concentration of the metals within a sample, voltammetry can also offer differentiation between various oxidation states of the impurity metal ions or between free and bound metal ions. This therefore allows statements to be made about the biological availability and toxicity of the impurities under investigation and thus makes this technique particularly suited for environmental analysis. With spectroscopy it is only possible to make such statements afte r the complicated separation of the metal species. Analysis of samples within media with high ionic concentrations can also be carried out by voltammetry which means that this technique is appropriate for the analysis of water, wastewater and seawater, salts and pure chemicals, electroplating baths, or foodstuffs. In addition to metals, a variety of organic compounds can also be determined. Consequently this technique is the analytical technique of choice described within a number of standards including those released by ASTM, HMSO, EPA and DIN. The purpose of the presentation was to outline Voltammetry as a possible alternative to the Spectroscopic methods currently used within the Electronics Industry for determination of trace impurities in electronic grade material.

6.2 An overview of Ion Mobility Spectrometry for Trace Analysis in Hydrogen, Oxygen and Helium presented by Marco Succi, SAES Getters (see attachment 13)

Ion Mobility Spectrometry is becoming a more widely used technique due to its extremely high sensitivity and quick response time. For this reason it is particularly applicable for the detection of explosives but in addition to this it is also gaining interest in the detection of impurities in UHP bulk gases used in the electronics industry. Work on the use of this technology for the analysis of impurities in mainly inert gases was presented at this forum last year. This

presentation served as a follow-up and covered more recent work which has mainly focused on the analysis of hydrogen, oxygen and helium where fast response times, sensitivity and stability in an instrument which has minimal moving parts and operates at atmospheric pressure can be clearly appreciated during operation with these gases.

7.0 ITRS Update

Jean-Marie Collard reported on behalf of Andreas Neuber. He explained about the background of alignment with ITRS, ITRS structure and joined activity with YE/WECC subworking group (see attachment 14).

NOTE: There was a joint meeting of the SEMI Standards Chemicals and Gases and related ITRS working group held the following day. A copy of these minutes is also publicly available upon request as attachment 15.

8.0 Proposed merging of the Gases and Liquid Chemicals committees

Jean-Marie Collard explained about the situation in the last few years since the Gases and Liquid Chemicals committees had been established and done their activity separately. Considering the current situation of activities and the limited number of volunteers, merging two committees would enable members to do their activities more effectively.

Gummaar De Vos of Arch Chemicals moved to merge the Gases committee and Liquid Chemicals committee, Reiner Taege from Air Products seconded the motion. All are in favor, motion passed.

9.0 Adjournment

Jean-Marie Collard thanked the participants for their participation. The next European meeting is scheduled for 6-8 October in Milan, Italy in conjunction with the SEMI Europe Standards autumn Conference and Meetings.

Minutes prepared by Bettina Weiss, Yukari Takeyama and Carlos Lee and approved by the committee co-chairs.

Attachment available upon request, please email clee@semi.org

List of attachments:

1. Standards Overview and anti-trust reminder
2. Meeting minutes from 30 October 2003
3. Liaison Report Liquid Chemicals North America
4. Liaison Report Gases Chemicals North America
5. Liaison Report Gases Japan
6. Liaison Report Facilities Japan
7. Precursors SNARF

8. Precursors TFOF
9. Ballot tallies
10. Doc. #3692 – Revision to SEMI C28 Specifications and Guidelines for Hydrofluoric Acid
11. Doc. #3693 – Revision to SEMI C53 Specifications for Dimethyl Sulfoxide (DMSO) Grades 1 and 2
12. Presentation - Trace Analysis with Voltammetry
13. Presentation - An overview of Ion Mobility Spectrometry for Trace Analysis in Hydrogen, Oxygen and Helium
14. ITRS, ITRS structure and joined activity with YE/WECC subworking group
15. ITRS / SEMI Standards meeting minutes

SEMI International Standards Program

Facilities Technical Committee meeting

22 April in conjunction with SEMICON Europa 2004

Meeting Minutes

Attendees:

Frank Frauenhoffer	acp-IT	frank.frauenhoffer@acp-it.com
Karsten Vogeler	Air Liquide	Karsten.vogeler@airliquide.com
Hideaki Ogihara	HA	hiogiha@attglobal.net
Dirk Rütterswoerden	M+W Zander	dirk.ruetterswoerden@mw-zander.com
Richard Köhldorfer	M+W Zander / Lang Peitler	Richard.koehldorfer@mw-zander.com
Hiromichi Enami	Renesas Technology Japan	Enami.Hiromichi@renesas.com
Carlos Lee	SEMI Europe	clee@semi.org
Paul Trio	SEMI North America	ptrio@semi.org
Hannspeter Pachel	Siemens	hannspeter.pachel@siemens.com
Artur Lederhofer	Siemens A&D	artur.lederhofer@siemens.com
Gaëtan Rocoffort	ST Microelectronics	Gaetan.rocoffort@st.com
Josef Hufnagl	Texas Instruments	j-hufnagl@ti.com

1.0 Welcome and Introductions

Hannspeter Pachel welcomed the participants and a round of self-introductions was done including function, company, location and motivation to participate.

The agenda was reviewed (see attachment 1)

Hannspeter Pachel presented a clear overview of SEMI and the Standards program and he also presented the anti-trust reminder (see attachment 2). The presentation highlighted on Facilities standards.

2.0 Review of the minutes from the last meeting

A copy of the minutes of the previous meeting held 30 October in Nijmegen was distributed (see attachment 3). After briefly reviewing the minutes, Dirk Rütterswoerden moved to approve the minutes as written. There were no comments, Artur Lederhofer seconded the motion, all in favor, motion carried.

3.0 Task Force Report

Dirk Rütterswoerden presented the Models for Data Processing Task Force report (see attachment 4). For the new participants, Dirk Rütterswoerden presented the goal of the task force, the TFOF (Task Force Organization Form) and SNARF (Standards New Activity Report Form).

A blue (informational) ballot was sent and the few comments received were reviewed at the task force meeting held the previous day.

Artur Lederhofer completed the presentation with some details and Hideaki Ogihara suggested to clarify the introduction and scope of the document (look at other SEMI Standards as an example).

There was a discussion whether the Information & Control committee should receive a lilac copy of the ballot, but most I&C members are not familiar with Facilities issues. Ogihara-san suggested that the EH&S committee should be the most logical candidate in receiving the lilac ballot.

ACTION ITEM: Artur Lederhofer to identify which committee would be best to receive a lilac copy of the ballot (maybe EH&S).

MOTION: Artur Lederhofer moved to distribute the MoFaS document #3713 for yellow ballot for cycle 5. Frank Frauenhoffer seconded the motion, 7 in favor, no objections, motion passed.

4.0 Liaison Reports

4.1 The Japan liaison report was presented by the Japanese Facilities committee co-chair Hiromichi Enami. Enami-san also presented a history timeline of the development of Japan Facilities standards (see attachment 5).

4.2 The North America liaison report was presented by Dirk Rütterswoerden (see attachment 6). Dirk suggested to Karsten Vogeler to contact Bob Irwin with respect to the North American F6 Revision (Guide for Secondary Containment of Hazardous Gas Piping Systems) task force for becoming the European liaison member.

5.0 Application and requirements at Texas Instruments in Freising, Germany

Hannspeter Pachel provided an example from the chemical industry (see attachment 7).

After this introduction, Josef Hufnagl from Texas Instruments based in Freising made a presentation that covered a General Overview of the facility, Facilities / Facilities Automation, Automation Standards and concluded with some Standardization requests. The presentation is available under attachment 8.

6.0 Further committee activities regarding required standards

Dirk Rütterswoerden presented the ideas generated at previous meetings (see attachment 9) and opened for new topics. Dirk reminded that any new idea should be accompanied by a task force and there should be a minimum of people involved and committed to develop the time necessary for the standard development. A discussion followed among the participants and a possible next topic identified:

Develop a common understanding of needs and requirements that would allow minimization of operating costs when running Facilities. Identify the key indicators that help to support this. Prioritize which ones to look at in more detail. Afterwards decide whether further activities would be advisable.

Example: The European Market Liberalization for Electricity Distribution and Stock Market requires to make agreements for Power Consumptions down to 15 minutes – exceeding the agreed power consumption results in penalties to be paid.

7.0 Adjourn

Hannspeter Pachel and Dirk Rütterswoerden thanked the participants for attending. The next European meeting will be held 6-8 October in Milan, Italy in conjunction with the SEMI Europe Standards autumn Conference and Meetings (with the support of STMicroelectronics). More information on www.semi.org/eustandards2004

Minutes prepared by Carlos Lee and approved by the committee co-chairs Dirk Rütterswoerden and Hannspeter Pachel.

Attachment available upon request, please email clee@semi.org

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各廠商在 e-Manufacturing 和 e-Diagnostics 二項領域簡報資料

(1).e-Manufacturing and e-Diagnostics at Infineon－－－－－　B1-B4

(2).e-Diagnostics/e-Manufacturing requirements and successes at AMD －－－－－－－－－－－－－－－－－－－－－－－－－－－－　B5-B15

(3).SEMI I&CC Standards Improvement－－－－－－－－－－－－　B15-B22

(4).e-Diagnostics- Reality and Vision (AIS)－－－－－－－－　B23-B36

(5).e-Diagnostics (ASML)－－－－－－－－－－－－－－－－－－　B37-B42

(6).Effective APC/FDC Through Data Quality (SI automation)－　B43-B50

(7).Standards Status Including Improvement Efforts－－－－－　B50-B54

Infineon

e-Manufacturing Workshop

April 20th, 2004 - Munich

e-Manufacturing and e-Diagnostics at Infineon

Ralf Georgi
Automation Capabilities Management

Never stop thinking.

Never stop thinking

Status of 300mm Equipment Automation

- 300 mm standards are **productive**
  - **E37 HSMS** (Ethernet to all tools)
  - **E87 CMS** Carrier Management
  - **E40 PJM** Process Job Management
  - **E94 CJM** Control Job Management
  - **E90 ST** Substrate Tracking (increasing usage)

  Wrap up is necessary by **GEM300** Taskforce
- Basic Interoperability is defined
  - **300 mm Operational Scenarios v 9.0**
- Error Handling Scenarios will be defined
  - **MOES** guideline v 2.0 (Manufacturing Operation and Error Handling Scenarios)
- Areas of standardization are extended
  - **E116 EPT** Equipment Performance Tracking
  - **E127 IMM** Integrated Metrology
  - **E109 RM** Reticle Management

IFX eManu_0404_IFD/CP
Page 2

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Current Equipment Automation Gaps

- Remote connectivity for trouble shooting
- Adequate usage of network
- Data rate limited
- Generic tool documentation vs. tool configuration
- Unformatted binary recipes

IFX eManu_0404_IFD/CP
Page 3

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Remote Connectivity

- Several e-Diagnostics solutions by Equipment suppliers existing, using different IT technologies
- Impossible to install and maintain 50 different supplier solutions
- Strategically Infineon needs a centralized e-Diagnostics solution for all tools (by a third party supplier)
  - owned and administrated by Infineon
  - to protect our IP and keep IT efforts at acceptable level
- Evaluation and pilot project ongoing at Infineon Dresden

→ Standardized **e-Diagnostic** functionality and **Interface A** (Equipment to fab) and **Interface C** (supplier to fab) is necessary to achieve this

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Adequate Usage of Network

- All 300 mm tools are connected via Ethernet TCP/IP
- Still using the point to point connection like the previous serial connection and the SECS data structure
- Takes no advantage of networking / internet capabilities rather than the higher data rate

➔ Common available **Internet technology** should be made available to the Semiconductor Industry

➔ Broad usage of **XML** is a precondition

Data Rate Limited

- Current data rate with SECS II is limited to 150 data points per s
- Insufficient for complex and fast (multi chamber) tools

➔ **DCM Data Collection Management**

will provide a more flexible, intelligent and faster way for Data Collection with Data Collection Plans:
The Tool pushes the data to the certain application when needed

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Generic Tool Documentation

- Data item lists currently provided are often plain lists, not describing the relation / belonging of data and status variables to a tool module / location (chamber)

➔ **CEM Common Equipment Model**

provides a methodology for an object oriented Equipment model

- Equipment documentation is currently often generic for the tool type and not created for the certain configuration of the actual tool (if chamber A is installed on position 4, the data variable would have ID 123)

➔ **ESD Equipment Self Description**

provides a mechanism to explore the current and actual tool configuration

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Unformatted Binary Recipes

- Recipes are still most often unstructured binary and multi level
  - Recipe Management
  - Recipe Verification
  - Parameter adjustment for R2R

  is difficult and expensive

- While Infineon prefers to do R2R parameter adjustment by Recipe Parameter Lists (acc. E40) instead of manipulating recipes a standardized and interpretable recipe format will be a definite requirement in the near future!

➔ **RaP Recipe and Parameter Adjustment**

provides a structured, formatted and readable recipe format and mechanisms for recipe management and parameter adjustment

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Infineons TOS* Roadmap (*Tool Operation Specification)

E37 HSMS
E5 SECS
E30 GEM
E39 OSS
E87 CM
E40 PJM
E94 CJM
E90 STS
E84 PIO
E54 SAB
I300I Guidelines
ISMT 300 mm Scenarios
TOS II

E109 Reticle Mgmt.
E127 Integrated Metrology
#3682 Linked Litho
E116 Equipment Performance
E126 EQIP
Data Utilization (FDC, R2R)
#3652 Data Quality Guideline
HVM Guideline (MOSE)
e-Diagnostics Guideline
TOS III

E121 XML Style Guide
E128 XML Message Structure
#3570 XML Common Components
#3851 Measurement Units in XML
E132 Authentication
#3509 Data Collection
E125 Equipment Self Descr.
E120 Common Equipment Model
#3571 Equipment Data Collection Guide
EDA Port (Interface A)
e-Diagnostics (Interface C)
E133 PCS (Interface B)
#3442 Recipe and Parameter Adjustment
EEC Guide
TOS IV

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e-Diagnostics/e-Manufacturing requirements and successes at AMD

Stephan Gramlich
April 20, 2004

Agenda

AMD

- **e-Diagnostic strategy**
- Results in individual projects
- e-Diagnostic / e-Manufacturing Security Framework (NIST ATP Project)

Strategy

AMD

1. AMD wants a single universal e-Diagnostics approach that can support all OEMs.

   We don't want a different proprietary solution from each OEM, each requesting their own server installed at AMD.

2. Security is of paramount concern. AMD must be able to protect its IP and control access to the tools.

Strategy (cont.)

AMD

3. We prefer the e-Diagnostics solution be provided by an independent 3rd party rather than one of the OEM's. With this approach we can ensure the e-Diagnostics solution provides AMD with security controls we can trust.

4. The business issues surrounding e-Diagnostics still need to be resolved:

   (a) who is going to pay for it and how ?

   (b) what are the quantifiable benefits to each party (OEM & chipmaker) ?

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Agenda

AMD

- e-Diagnostic strategy
- **Results in individual projects**
- e-Diagnostic / e-Manufacturing Security Framework (NIST ATP Project)

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Results in individual e-Diagnostic / e-Manufacturing projects

- Inspection tools and production tools from several OEMs connected via VPN and by using SecurID
  - ~ 25% of all issues can be solved by using remote diagnostics
- On-site data collection server for tools from several OEMs
  - Supports central onsite monitoring
- Implementation of SAP Plant Maintenance to manage PM & CM activities incl. automated parts ordering and tracking process

Agenda

- e-Diagnostic strategy
- Results in individual projects
- **e-Diagnostic / e-Manufacturing Security Framework (NIST ATP Project)**

Background

AMD

- Team has a 3-year NIST ATP award totaling about $ 10 million
  - Project title: "eManufacturing security framework to improve semiconductor productivity"
  - U.S. Government funds 49.99 %, participants fund 50.01 %
  - Project started in November 2001
- The project currently has 3 Joint Venture Partners
  - **AMD**
    - Project Administrator
    - Provides fab requirements & pilot site
  - **ILS Technology**
    - e-Diagnostics and Automation Applications (eCentre)
  - **Oceana Sensor Technologies**
    - Wireless e-Diagnostics Applications
    - Advanced Wireless Sensor Systems

Project Goals and Objectives

AMD

- **Objective**
  - Enable collaborative manufacturing for mutual benefit while protecting intellectual property
- **Goals**
  - Develop an ***open security framework*** for collaborative manufacturing that allows dynamic, fine-grained security controls

Why Collaborative Manufacturing ?

- Wafer fabrication plants can significantly increase productivity of manufacturing tools by
  - Increasing tool up time
  - Decreasing non-product wafers
- OEM's can increase productivity by
  - Reducing travel costs
  - Providing specialized expertise quickly, efficiently
- Meaningful gains require collaboration among tool suppliers and chipmakers to resolve problems
  - Electronic interaction offers the most cost effective and quickest means to collaborate
- Security is a major concern in electronic collaboration
  - Intellectual Property, Tool Control, Recipes, Safety

What's Different ?

- Other efforts are addressing connection security
  - Establishing a secure pipe between the remote site and the fab tool
  - Controlling basic access, i.e. user authentication
- Our Security Framework addresses content security
  - What specific data items can be accessed ?
  - What commands can be issued ?
  - Under what conditions ?
    - May depend on dynamic factory state (tool, MES, etc.)
    - May depend on other active users
    - May depend on aggregation of data items
  - How should the data be transformed ?
    - Hiding, categories, ranges, selective sampling, etc.
  - What security is required as data is moved within the fab ?

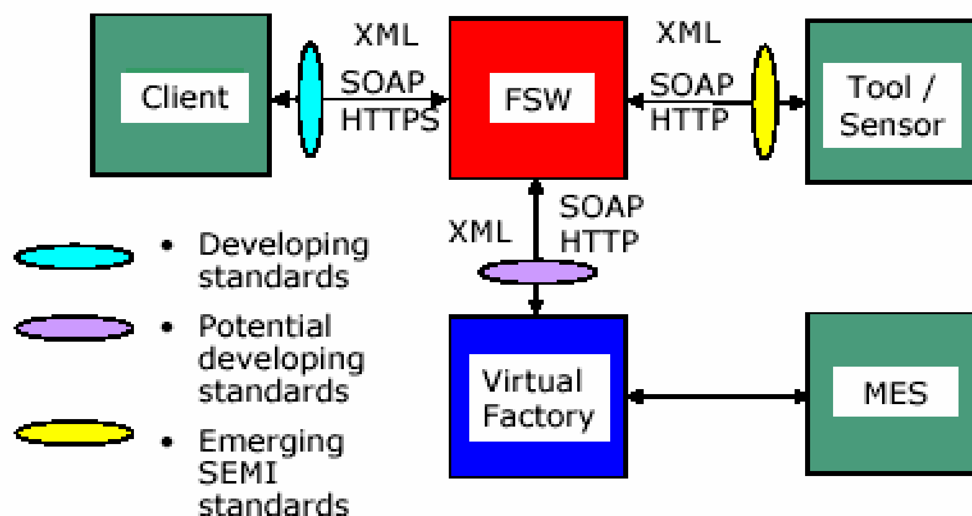
Open Security Framework

AMD

- What is an *open security framework* ?
  - External interfaces are published and become standards
  - Anyone can develop and market a Security Framework that complies with the interface standards
  - Anyone can develop and market collaborative applications that integrate with any standards-compliant Security Framework
- Our project is developing the first implementation of the Security Framework: Flexible Security Wrapper
  - Leverages existing standards (XML, SOAP, etc.)
  - Uses emerging SEMI standards (Interface A) where possible
    - Ballot 3509, E125, E120, E121, E132
  - Influence changes to standards where experience/analysis shows a need

FSW Interfaces

AMD



Phase I – Security Framework

AMD

- **Status – Phase I is completed (January 2003)**

  ✓The first implementation of the FSW has been developed and tested in a simulated factory environment

  ✓The approach is feasible

  ✓Performance is encouraging

  ✓Additional refinements planned in Phases II and III as the FSW is integrated with representative applications

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Phase II – Secure e-Diagnostics

AMD

- **Status – Phase II is nearing completion (April 2004)**

  ✓Developed a GUI to graphically define security rules

  ✓AMD and Semitool developed e-Diagnostic requirements & evaluation criteria for a pilot

  ✓NIST team developed an e-Diagnostic application based on ILS' eCentre and integrated it with the Flexible Security Wrapper

  ❖Pilot in progress at AMD's Submicron Development Center with Semitool Plater and ACMS chemical management system

  ❖Feedback from outside security experts currently being incorporated into the FSW based on the results of simulated attacks in the prototype environment

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Phase II – Secure e-Diagnostics

AMD

- **Preliminary Results**
  - The e-Diagnostics capability is useful for troubleshooting problems that required specialized expertise such as software issues
  - Useful for applying patches and performing tricky software upgrades with the assistance of remote experts
  - AMD tool owners find the Remote Tool Operation capability (front panel access from office/home) useful for performing their daily duties

Phase III – Secure e-Manufacturing

AMD

- **Tasks**
  - Evaluate productivity opportunities and applications
  - Develop and test equipment control applications
    - Alternative e-Diagnostic architectures
  - Develop and test FIPS 140 security application
    - Federal Information Processing Standard for sensitive information
  - Develop and test process control applications
    - Integration of FSW security with fab process control systems as well as industrial process control in non-SEMI industries
- **Status - Phase III is in progress**

  ✓Completed evaluation of current challenges and opportunities and developed an updated list of applications

  ❖Requirements analysis and design underway for several applications that will be integrated with the FSW

Commercialization Status

AMD

- The commercial release of eCentre currently supports file transfer (FTP) and Remote Tool Operation (RTO) very robustly. These features have been available commercially for some time.

- eCentre 2.1 contains the first commercial release of the data collection plan (DCP) management functions and is capable of communicating with a Flexible Security Wrapper (FSW).

- The FSW is not yet commercially available

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Summary

AMD

- **Conclusions**
  - It is feasible to develop an *open security framework* to allow collaborative manufacturing while protecting intellectual property
  - The *open security framework* can provide fine-grained control of data/commands, dependent on dynamic factory conditions, with acceptable performance
  - e-Diagnostics provides benefits to both chipmakers and OEM's
- **Tool Suppliers**
  - We're looking for additional OEM's for pilot projects
- **Questions ?**

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Europe 2004 STS e-Manufacturing Session

SEMI I&CC Standards Improvement

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Outline

- Lessons Learned from 300 mm
- How do we improve going forward?
- SITF Purpose and Outputs
- Streamlining Procedures
- Communication
- Standard Improvement
- Concurrent Activities Concept
- Future Considerations
- Challenges

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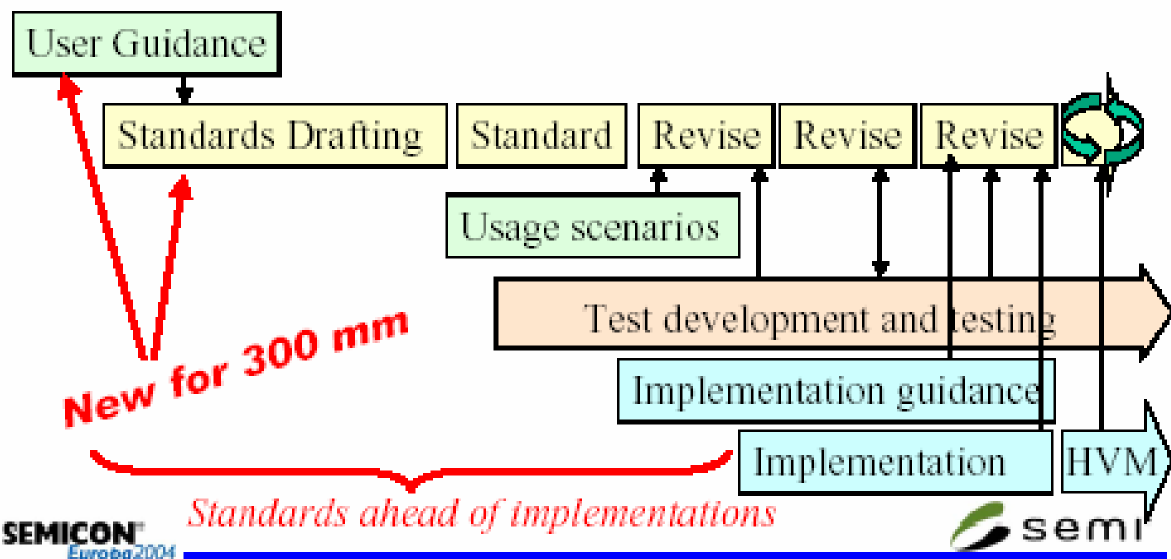
Lessons Learned from 300 mm

- Standards were developed and documented before tools and fabs were built
- Standards requirements were difficult to identify, interpret, implement and test
- Learning from test development, implementations, testing and application in a high volume manufacturing (HVM) production environment after standards were published caused several cycles of revisions to the standards.



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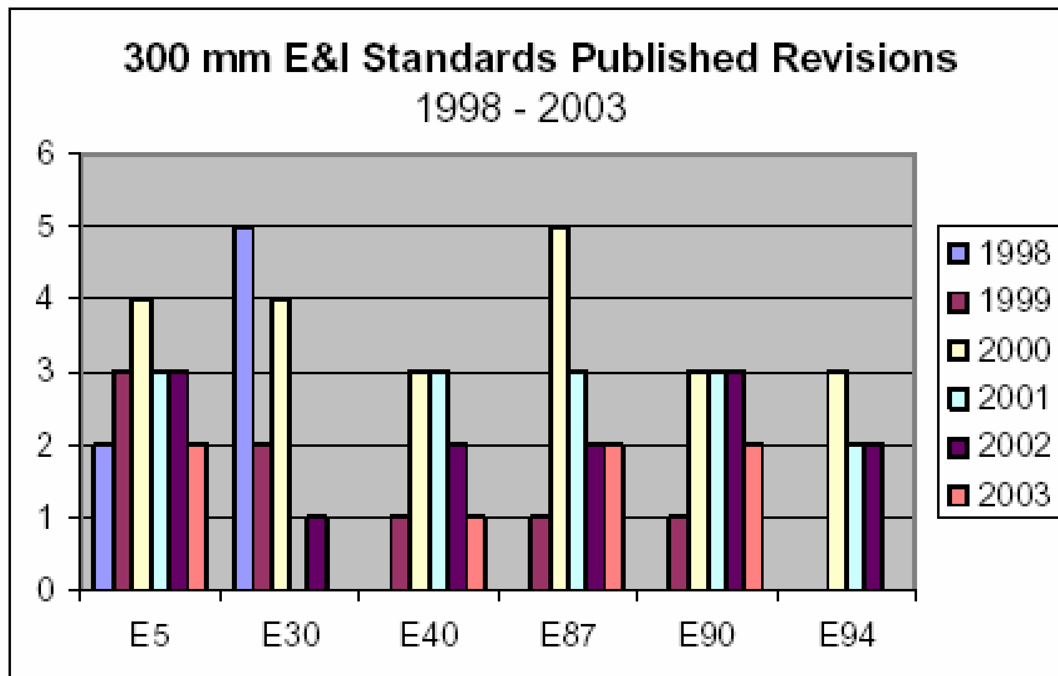

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How do we improve going forward?

- Streamline Committee processes and procedures
- Improve communication globally
- Improve how we write standards
- Encompass concurrent industry activities in standards development plan

- The Global I&CC Standards Improvement Task Force was formed to catalyze and facilitate improvement

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Streamlining Procedures

- Updated Meeting Motions templates
  - Streamline and improve ballot reviews
- Templates for line items (single and multiple)
  - Improve format and background statement of line items
- Task force issues tracking template
  - Communicate issues on existing documents and track progress to resolve issues
- SNARF template updates
  - Identify participation needed for standards development
  - Provide history of revisions to ballot in SNARF

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Communication

- SITF and I&CC 'Quickplace' on SEMI website
- Standards Roadmap Timeline
  - Ballot history and forecast, and links to TFOFs and SNARFS for I&CC, PI&C, Metrics, Microlithography, Traceability, ES&H, & Silicon Wafer
  - http://www.sematech.org/docubase/abstracts/4393beng.htm
- ISMT 300 mm Integration and Automation Guidance
  - Manufacturing Operations and Exception Scenarios
    - http://www.sematech.org/docubase/abstracts/4426beng.htm
  - Equipment Integration and Automation Software Flowcharts
    - www.ismi.sematech.org/standards/documents/300_os_v09.pdf

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Specification Template

- A Specification Template for I&CC standards is in development to include detailed guidance for authors
  - Format
  - Revision history
  - Alignment of SNARF with scope of standard
  - Location of requirements in a specification
  - Writing requirements clarity and unique identification
  - Conventions
  - Testability
  - Exception handling
  - Statement of compliance
- The draft is being sent to I&CC members to gather more input and feedback

Writing Clear Requirements

Examples of issues from current standards:

- "The equipment is responsible for communicating all EPT state transitions."
- [Is this a requirement? Should "is" be changed to "shall be"?]
- "The EPT state model can be applied to the Equipment Front-End Module (EFEM)."
- [Is a "can" sometimes a requirement and sometimes not?]
- "The state of the EFEM/carrier/load port related modules shall not impact the overall equipment state."
- [Since this is a negative requirement, is this testable?]
- Implied requirements: E94 implies that more than one process or control job can be run concurrently, but does not support parallel execution of control jobs
- E90: There are too many possible permutations to validate by testing that E90 events sent by an equipment actually match the location path taken by the substrates as determined by the recipe

Unique Requirements ID

- Proposal: Each requirement shall be uniquely identified as a requirement of the standard
- Advantages
  - Drives consideration of how requirement is written, and whether it is testable
  - Identifies each requirement regardless of where it is located in the standard
  - Makes it easier to extract all requirements from a standard
  - Facilitates ease of implementation and test development
  - Mapping to requirements does not change, even if the location of the requirement in the standard changes
  - Facilitates revision tracking
- A schema and structure for Unique IDs is in development [e.g., RQ-E116-EPTSM-00116]

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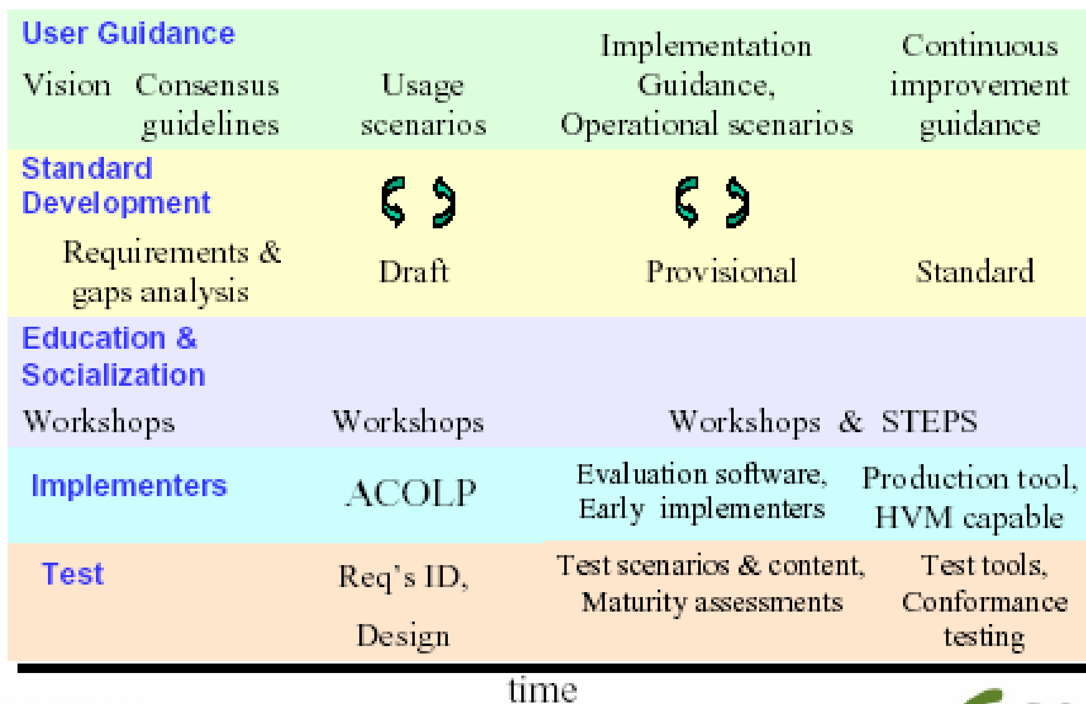

Accelerated Cycles Of Learning Prototypes (ACOLP" – *Steve Fulton, ISMI*)

- Prototypes early in the standards development cycle with the specific purpose to:
  - Assess the feasibility of a new or unfamiliar technology to be addressed by a standard
  - Assess or mitigate technical risk of approving a standard
  - Validate a standard approach from potential alternatives
  - Identify gaps and refine technical content of a standard
  - Verify specifications and test requirements
- Impact:
  - Reduce revisions of published standards
  - Reduce impact of revisions on implementations
  - Earlier implementations due to higher certainty of content

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Future Considerations

- Addendum Guidelines to Members Handbook for I&CC for standards developers
- Work with SEMI staff to provide standards in different formats (other than in .pdf)
- Test requirements strategy

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Challenges

- Global agreement on and adoption of SITF proposals for improvement
- The window of opportunity to improve emerging "e" standards is narrowing fast
- SEMI standards volunteer role definition and resources to effect change
- SEMI resource and policy constraints to support change
- Industry (device makers and suppliers) commitment and funding to support the improvements throughout standards life cycle

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SEMI Standards On-Line Collaboration

- Contact your SEMI standards coordinator for access and passwords
  - Information and Control Committee: http://teams.semi.org/stds_ic
  - Global I&CC Standards Improvement (SITF) http://teams.semi.org/QuickPlace/stds_icspitf
  - Diagnostic Data Acquisition Task Force NA http://teams.semi.org/stds_icdda
  - Object-Based Equipment Model (NA OBEM) Task Force http://teams.semi.org/obemtf

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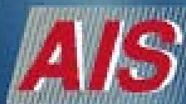
Automation: Our World.

e-Diagnostics - Reality and Vision

Eckhard Schöbel
Vice President
Research and Development



Automation Dresden GmbH

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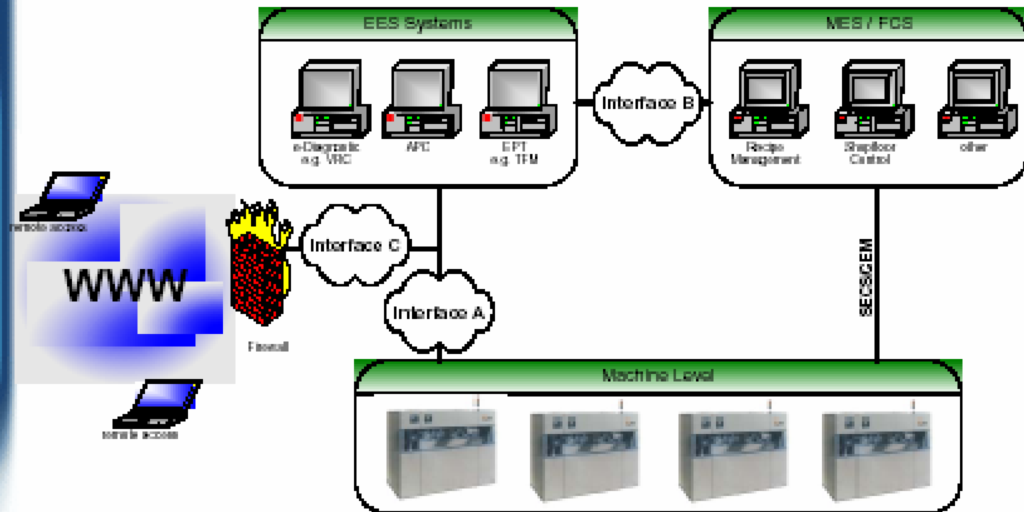
Agenda

- First steps to e-Diagnostic (EDA,RDAT)
- e-Diagnostics – Cooperation with ISMT
- Scenarios for the e-Diagnostics system
- EDA – The new interface (Requirements and Basics)
- Next step: Interface "C"
- Vision for fab-wide e-Diagnostics
- Summary

Agenda

First steps: The big picture of the new standards



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First steps: e-Diagnostics Requirements

- **Remote Connectivity**
  Ability to connect remotely to the tool to receive status and process data.
- **Predictive/Automated Maintenance**
  Detect situations which require maintenance, predict next maintenance actions automatically
- **Automated Notification**
  Inform tool owner (at ICM's site) and Equipment supplier about critical situations and failures.
- **Remote Tool Operation**
  Operate the tool using a remote connection.
- **Remote Performance Monitoring**
  Collect performance data from the equipment and allow statistics as well as notifications.
- **Logging / Reporting / Analyzing Functionality**
  Data collection triggered by suppliers (or ICM's) to generate logs or reports during the productive or engineerig runs to ensure stability of the process and tools.
- **Self diagnosis**
  Self diagnosos of the tool functionality and critical parameters.
- **Security issues**
  Ensure intellectual property of data

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First steps: SEMATECH Guidelines for e-Diagnostic

Level 0
Access and Remote Collaboration
Remote connectivity to applications and production tools and remote collaboration capabilities

Level 1
Collection and Control
Remote tool operation, remote performance monitoring, data collection and storage

Level 2
Analysis
Automated reporting and Advanced Analysis with SPC capability

Level 3
Prediction
Predictive maintenance, self diagnostics, and automated notification

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First steps: Motivation for e-Diagnostics in High Volume Areas

Infineon Dresden

300mm Fab

Dresden panorama

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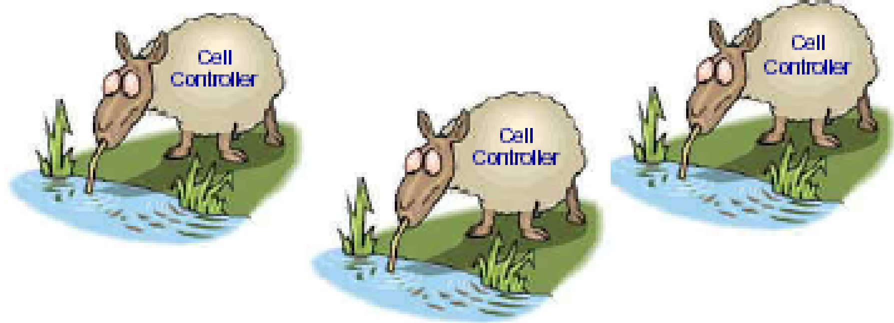
First steps: Motivation and History for e-Diagnostics (RDAT – only to Cell Controller)

Infineon Dresden

300mm FAB



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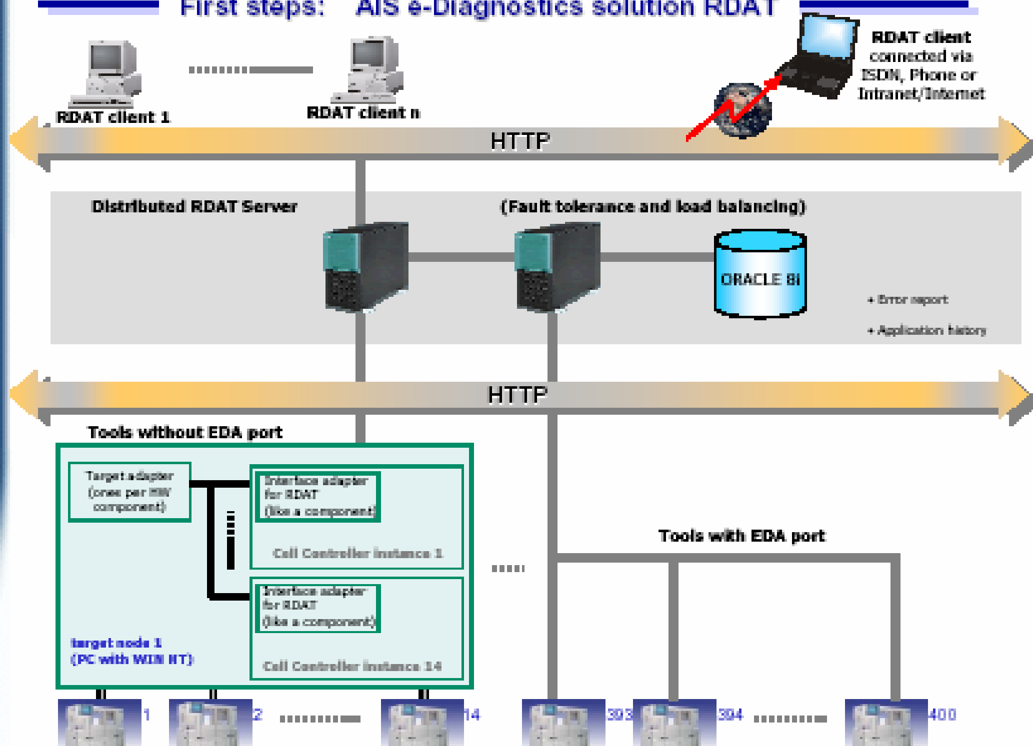
First steps: AIS e-Diagnostics solution RDAT



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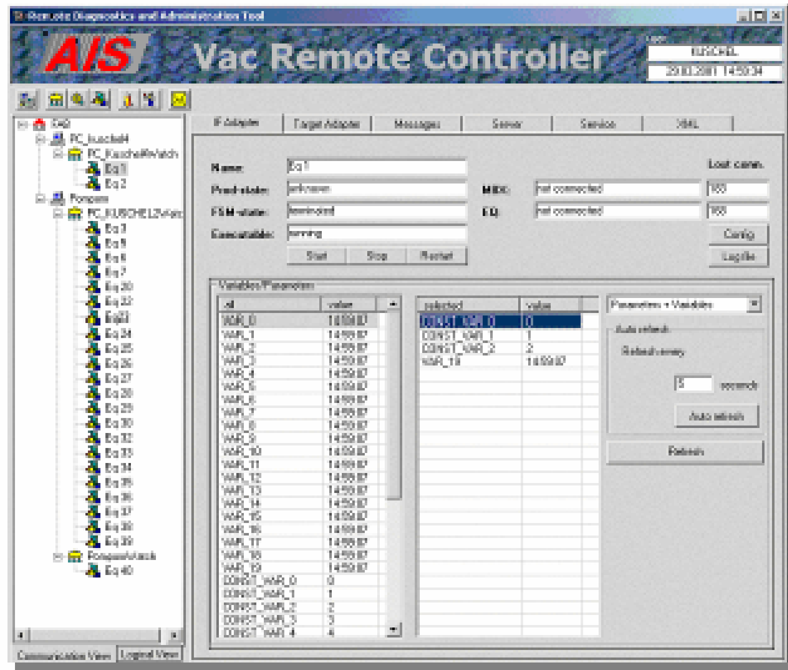
First steps: Capabilities of RDAT

observation of variables (e.g., pressure, temp., gas flow, ion beam)



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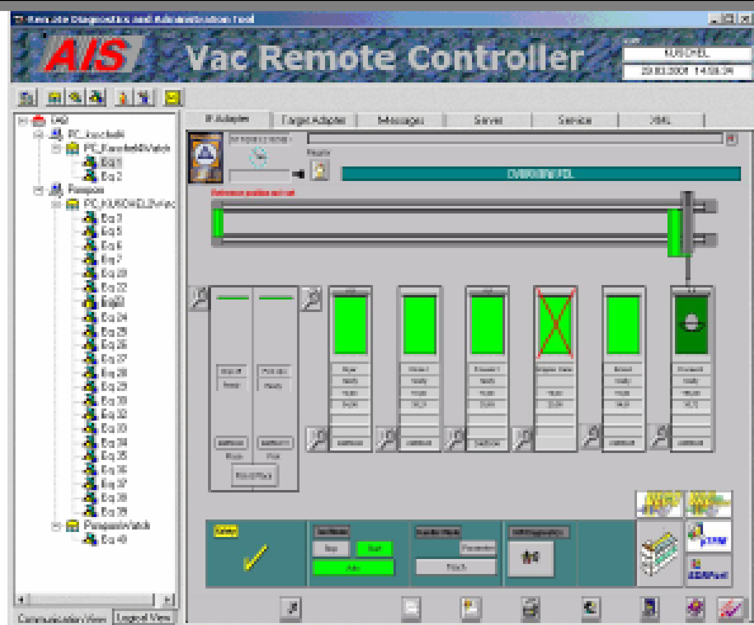
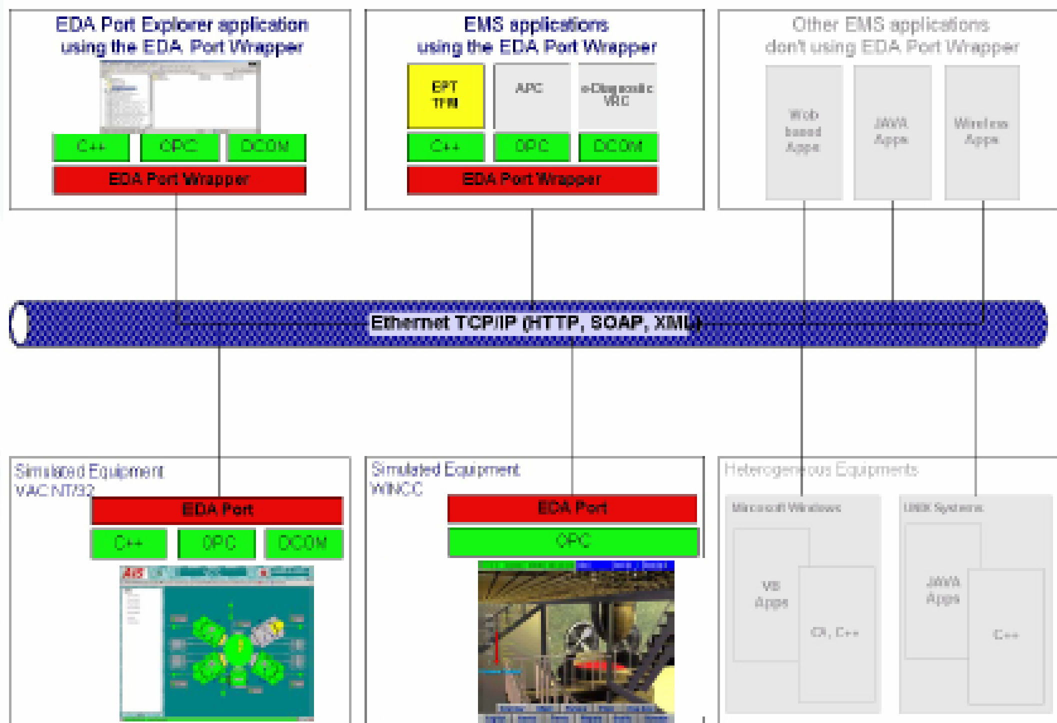
First steps: Capabilities of RDAT

- remote screen capture
- interactively work on the tool with permission of the factory

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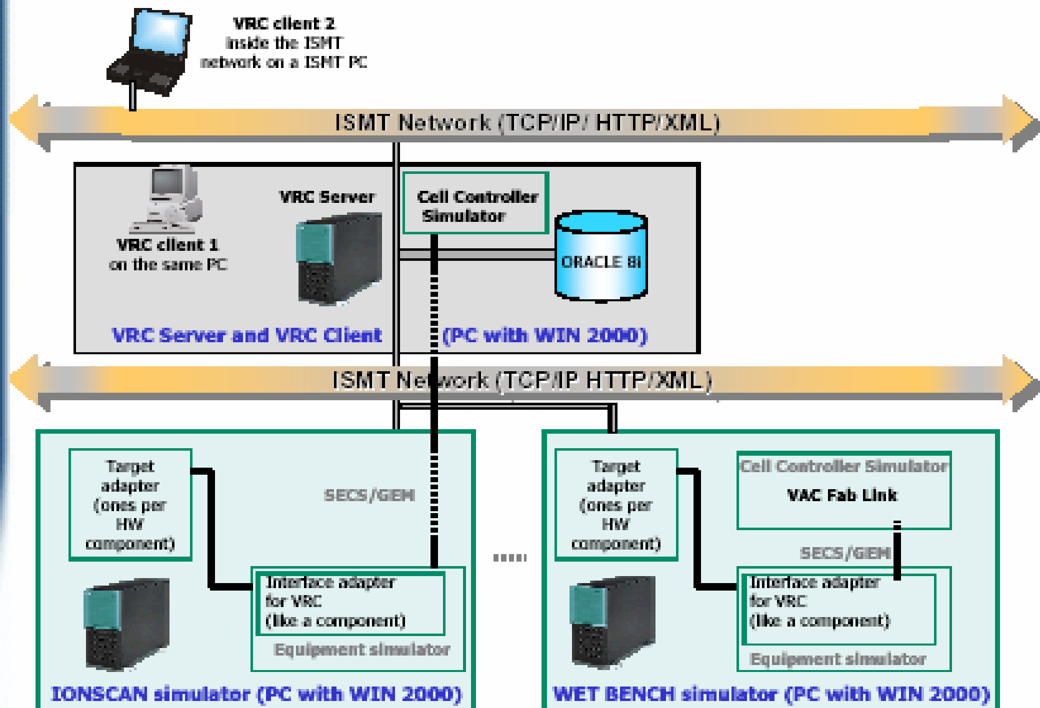
Cooperation with ISMT: EDA Demonstrator
EDA Port Explorer application using the EDA Port Wrapper
C++
OPC
DCOM
EDA Port Wrapper
EMS applications using the EDA Port Wrapper
APC
C++
OPC
DCOM
EDA Port Wrapper
Other EMS applications don't using EDA Port Wrapper
JAVA Apps
Wireless Apps
Ethernet TCP/IP (HTTP, SOAP, XML)
Simulated Equipment VAC NT/32
EDA Port
C++
OPC
DCOM
Simulated Equipment WINCC
EDA Port
OPC
Heterogeneous Equipments
JAVA Apps
C++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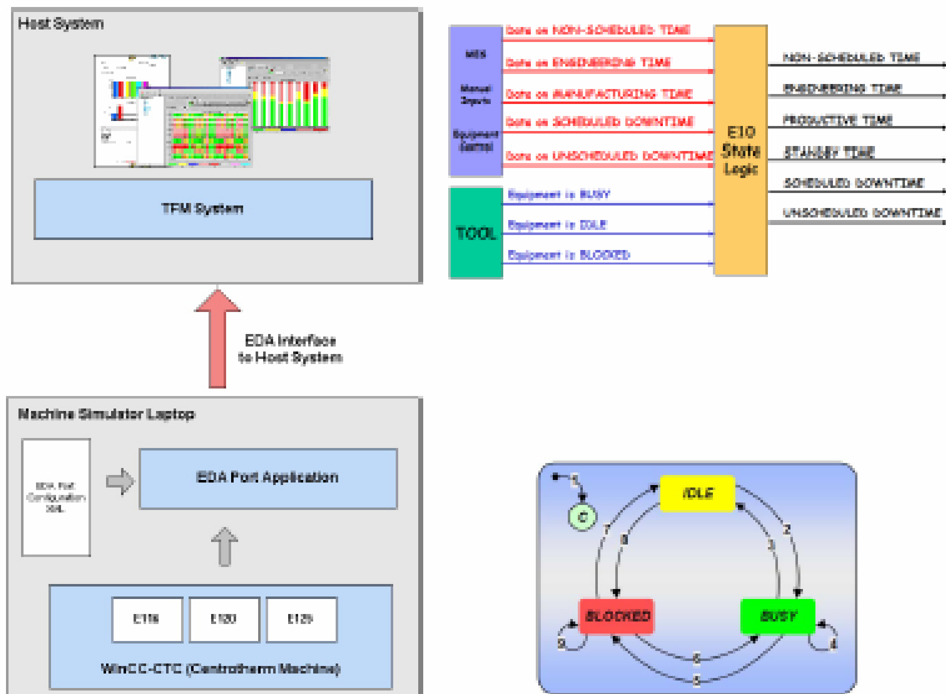
Cooperation with ISMT: e-Diagnostics with RDAT
VRC client 2
inside the ISMT
network on a ISMT PC
ISMT Network (TCP/IP/ HTTP/XML)
VRC Server
Cell Controller Simulator
VRC client 1
on the same PC
ORACLE 8i
VRC Server and VRC Client
(PC with WIN 2000)
ISMT Network (TCP/IP HTTP/XML)
Target adapter (ones per HW component)
SECS/GEM
Interface adapter for VRC (like a component)
Equipment simulator
IONSCAN simulator (PC with WIN 2000)
Target adapter (ones per HW component)
Cell Controller Simulator
VAC Fab Link
SECS/GEM
Interface adapter for VRC (like a component)
Equipment simulator
WET BENCH simulator (PC with WIN 2000)

Cooperation with ISMT: EPT Demonstrator



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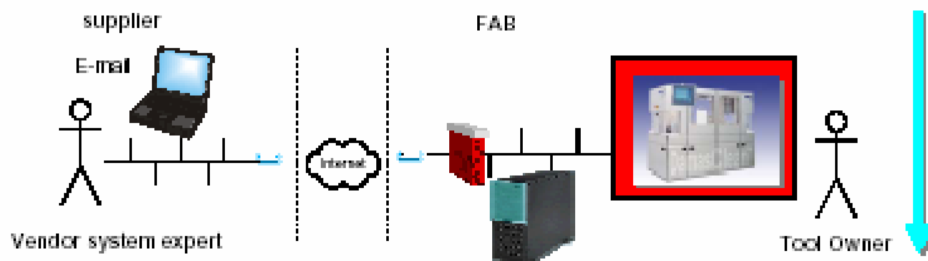
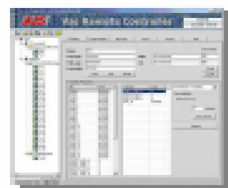
Scenarios for the e-Diagnostic system

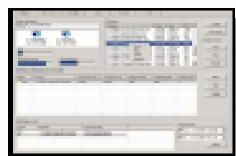
e-Diagnostics system send's automatically a e-mail after a critical alarm message occurs or the tool owner call's the system expert

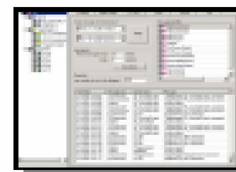


system expert start the analysis with the e-Diagnostics system



check the system utilization





check the alarm message list about other events

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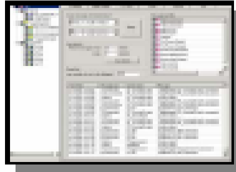
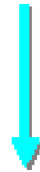
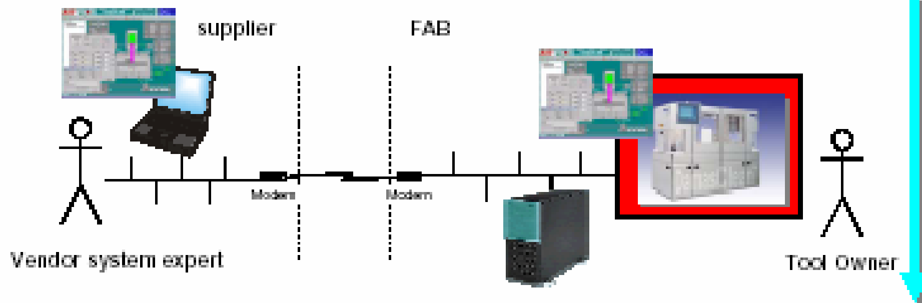
Scenarios for the e-Diagnostics system

enable special log function by setting some ECID's





under the observation of a tool operator the system expert can check the tool GUI with the remote control technology (e.g., VNC)



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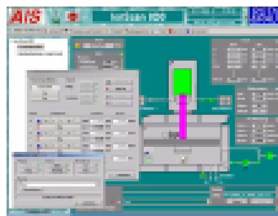
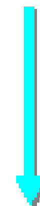
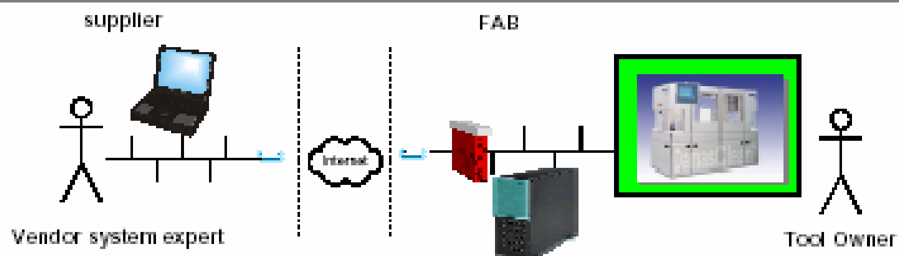
Scenarios for the e-Diagnostics system

on request of the system expert the operator shall do some special processes (e.g., leak-test, chamber cleaning)





now the tool works correct, the problem is fixed



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EDA: Requirements of the new interface

- Host independent data collection
  Clients can setup and collect data near realtime independent of host online/offline status
- Security
  only factory-authorized applications permitted to collect data, single point of control is enforced at factory level
- Self describing interface
  Equipment structure, implemented state models, available data items & types, events, exceptions and alarms can be learned at runtime from the tool
- High accuracy of data
  Worst case scenario: 1.000 scalar values with 10Hz data rate will be collected.
- Usage of mainstream technologies
  The data format should be XML transferred via HTTP/SOAP
- Logically separated interface
  Minimized influence of the new interface to the existing data connection and the process

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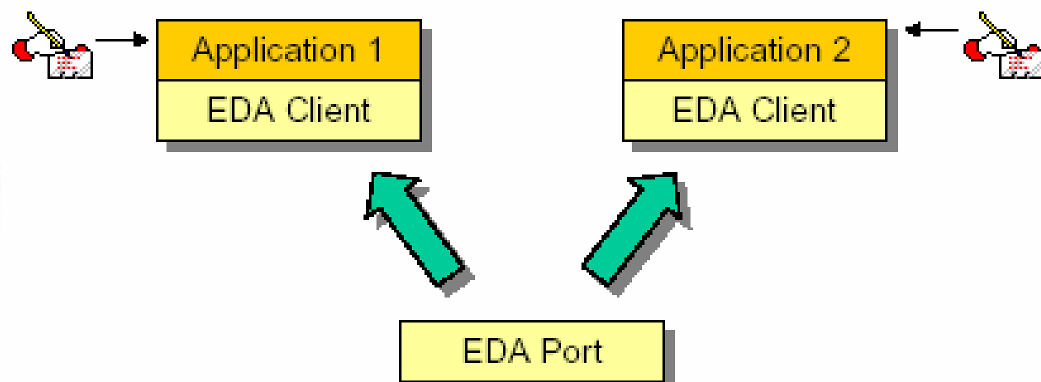
EDA: Multiple client support

- Each application can define its own data collection plans
- No cell controller necessary to „broadcast“ equipment data
- Integrated scenario on load problems (priorization)
- EDA Port stores the configured Data Collection Plans



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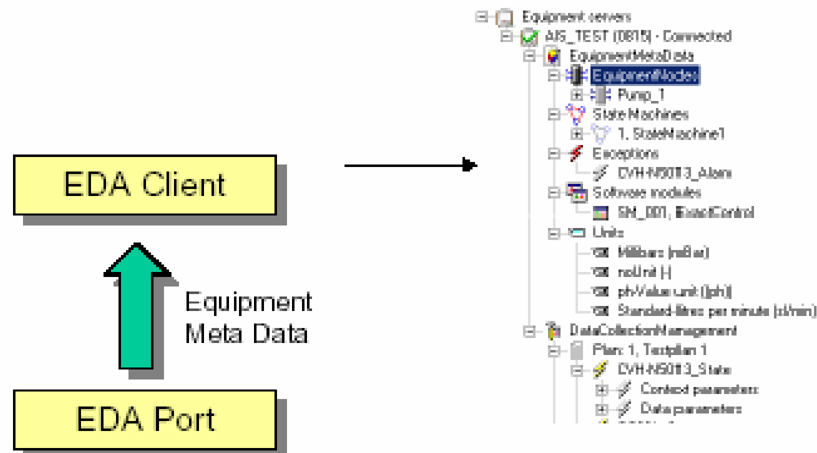
EDA: Equipment Self Description

- Interface describes itself about all data, alarms, events, ...
- Can be explored „on-line“ from the client
- Enables „drag & drop“ definition of data collection plans on-line



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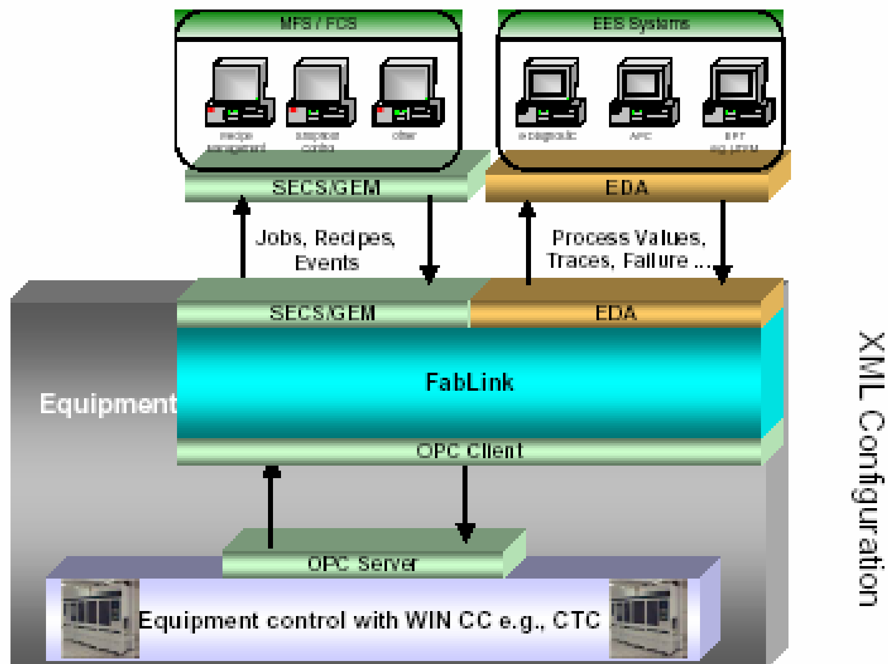
EDA: From a vision to the product FabLink



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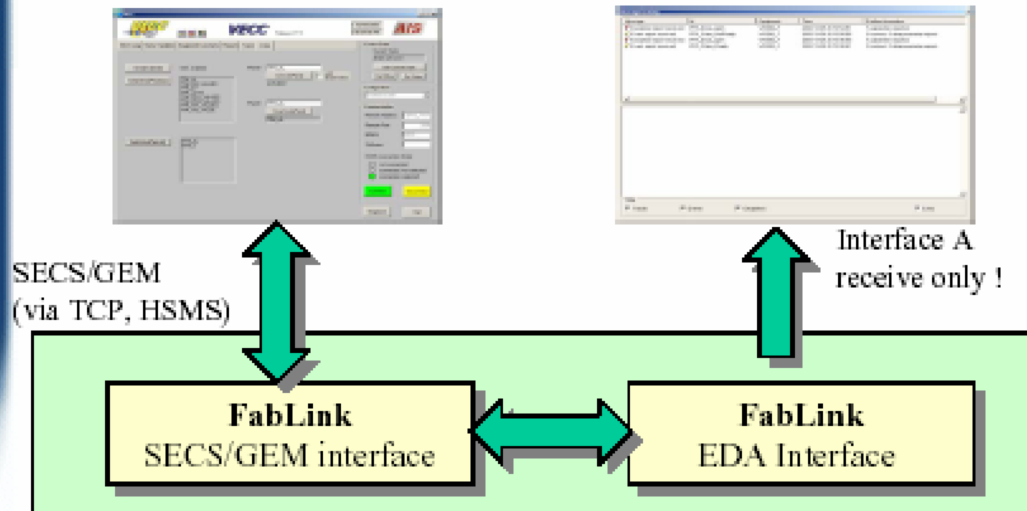
EDA : Data management using SECS/GEM port

- List
- Activate
- Deactivate

Data Collection Plans

Receive data



→ e-Diagnostics data will be controlled by (existing) Cell Controller Applications

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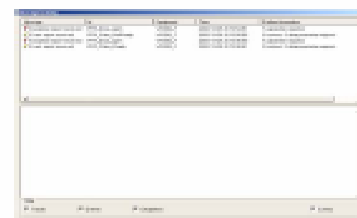
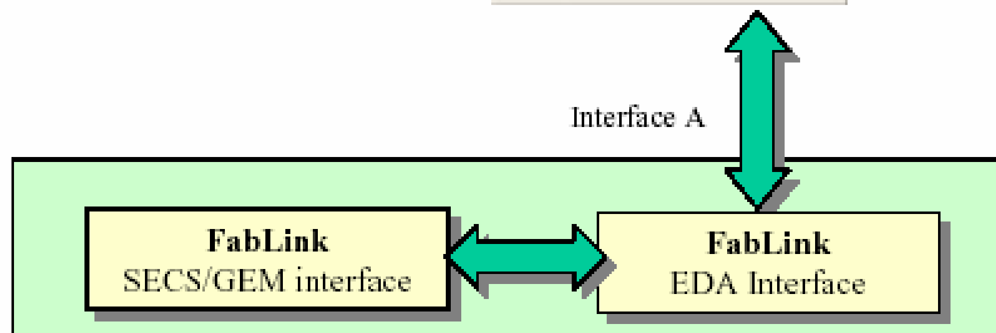
EDA: Data management using EDA port

- List
- Activate
- Deactivate
- Receive

Data Collection Plans



Interface A



→ e-Diagnostics data can be fully controlled by the e-Diagnostics solution

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Next step Interface „C“: Requirements

- Transmitted data is a subset of Interface A
  To protect intellectual property only a subset of Interface A data are transmitted
- Data sharing models: push/pull and subscription
  Both models will be supporte: subscription (timeframe, request, event based) and push/pull additional details
- No restriction on types of data
  Data to be transferred are agreed between supplier and chip maker
- Authentification, Authorization, Data security
  This is a key capability of interface C. Data transfer uses encryption to ensure intellectual property. Authorization for the functions: FTPable files for transfer, e-Diagnostics data, Remote Tool Operation.

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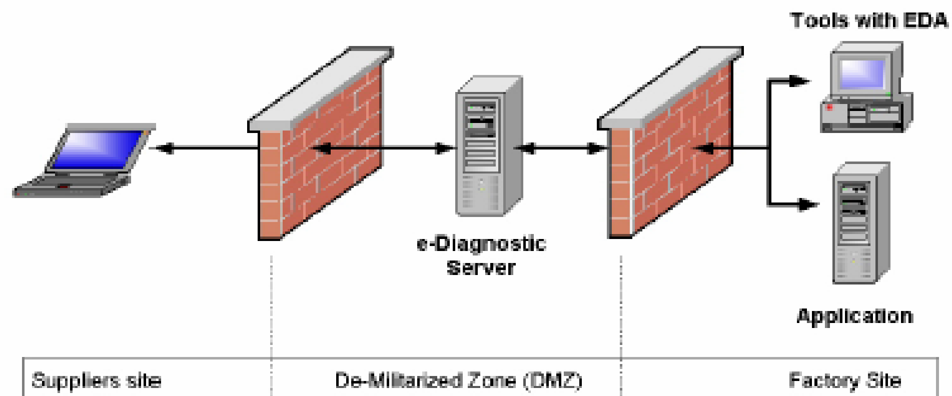
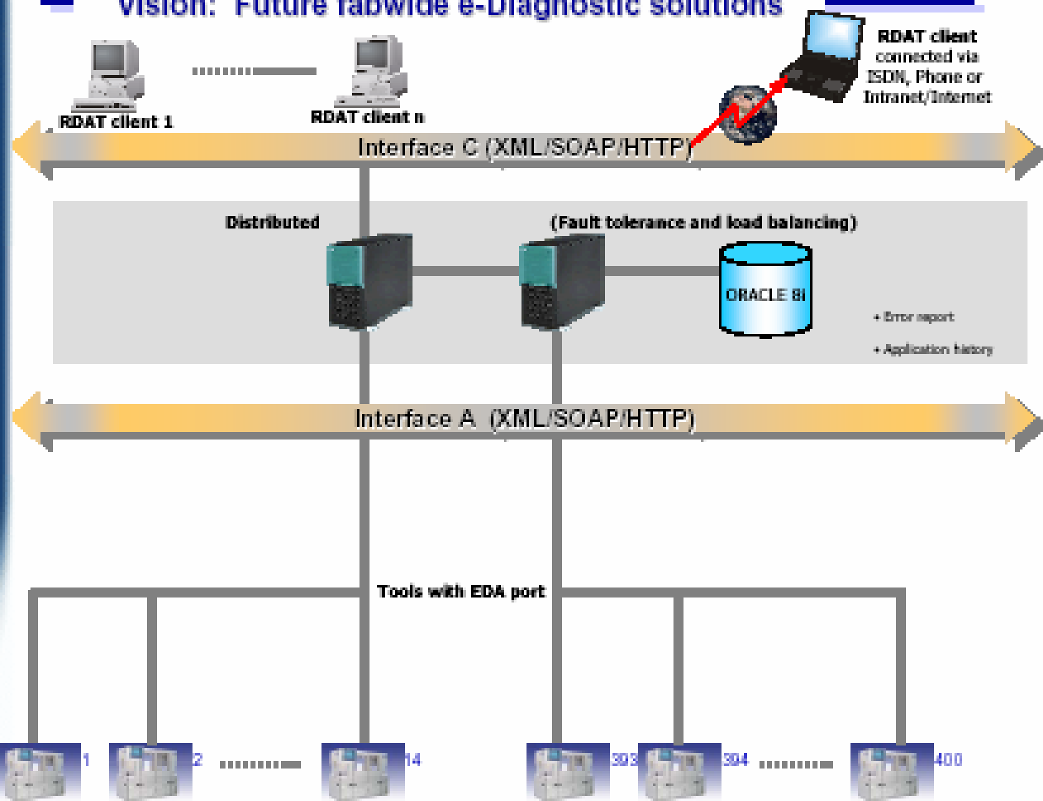
Next step Interface „C“: Architecture



- No direct tool connection, all data go through DMZ with Proxy functionality
- By default e-Diagnostics server lives in DMZ
- Authentification for each user required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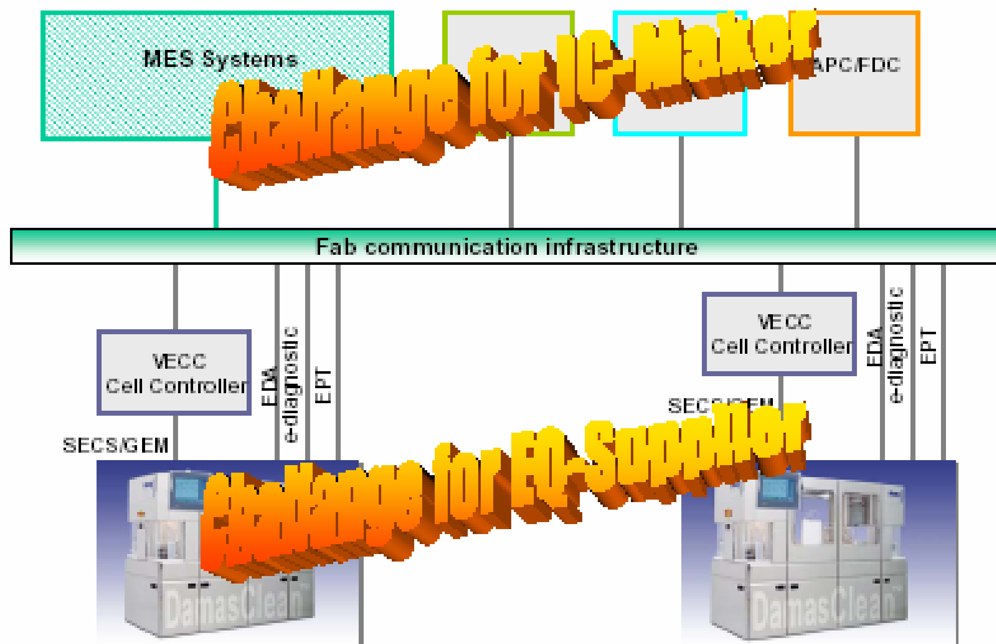
Vision: Future fabwide e-Diagnostic solutions
RDAT client 1
RDAT client n
RDAT client connected via ISDN, Phone or Intranet/Internet
Interface C (XML/SOAP/HTTP)
Distributed
(Fault tolerance and load balancing)
ORACLE 8i
Interface A (XML/SOAP/HTTP)
Tools with EDA port
1
2
14
393
394
400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Vision: Fabwide e-Diagnostics solutions
MES Systems
APC/FDC
Challenge for IC-Maker
Fab communication infrastructure
VECC
Cell Controller
EDA
e-diagnostic
EPT
SECS/GEM
Challenge for EQ-Supplier
DamasClean

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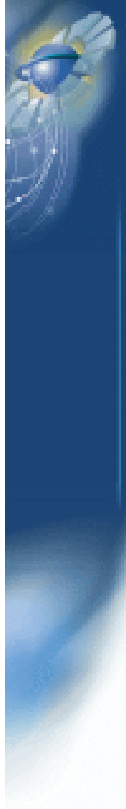

Summary

- e-Diagnostics systems should be driven by IC-makers
  e-Diagnostics should be a global service in the fab infrastructure (not only for tools!)
- ISMT Guidelines are a good basis for design and understanding
- SEMI Standard basis available for e-Diagnostics solutions
  PR8 (EDA port), E120 (Common Equipment Model), E125 (Equipment Self Description), E132 (Authentification and Authorization), (3509 Data Collection Management)
- EDA products available on the shelf
  EDA solutions available for EQ-suppliers and also for fab integration
- e-Diagnostics systems are ready for run
  A variety of tools already available on the market
- External Interface C already in preparation
  The new interface enables the use of internet for e-Diagnostic.
- Bi-directional interface would be an advantage for e-Diagnostics and APC solutions
  Enables remote collaboration on the tool and external controllers.

We have what we need for e-Diagnostics.
So let's do it now !

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Thanks for your attention

SEMICON Europa 2004
Hall B3 booth 474 Siemens

SIEMENS

Hall B3 booth 368 Silicon Saxony

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schoebel@ais-dresden.de

e-Diagnostics

- status and lessons learned -

Lex Keij

ASML

20 April 2004

/ Slide 1

How did it start at ASML?

- 1998 First structural data collection (10 tools)
- 1999 Local Automatic Data Collection (ADC) (50 tools)
- 2000 Automatic data analysis and reporting focussed at reliability (300 tools)
- 2001 Global ADC introduced (700 tools) and first Remote Access Implemented
- 2002/2003 Added condition monitoring and configuration monitoring (1000 tools)

/ Slide 2

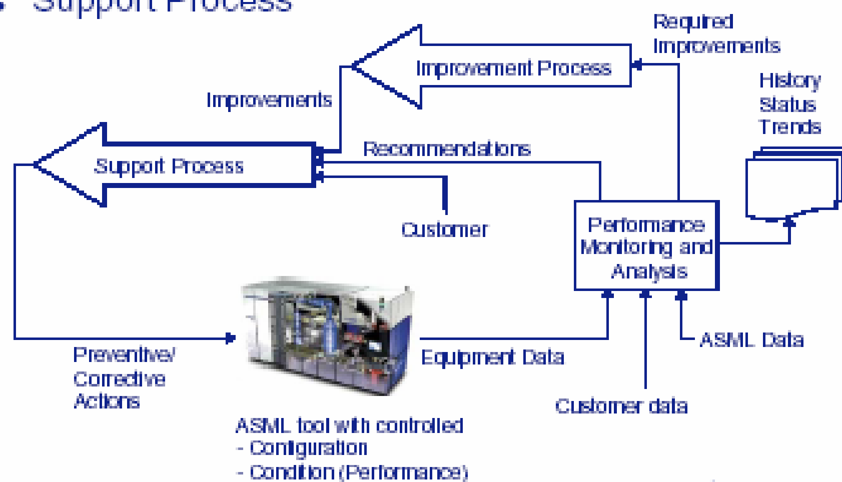
Status 2004

- Remote Access to 7 sites and 3 under install
- 1300 tools monitored daily (25.5.e^6 hrs to date)
- Analyzed data used for process management
- Project ongoing to add availability analysis
  - planned projects for additional condition and configuration monitoring
- e-Diagnostics pilots planned with customers
- e-Diagnostics integral part of roadmaps

/ Slide 3

Processes Supported

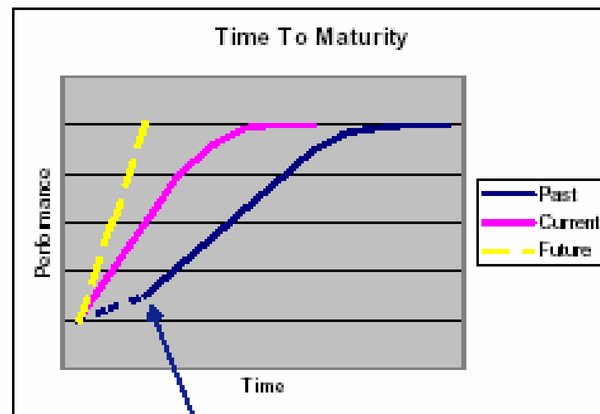
- RAM based
  - Continuous Improvement Process
  - Support Process



/ Slide 4

Continuous Improvement Success

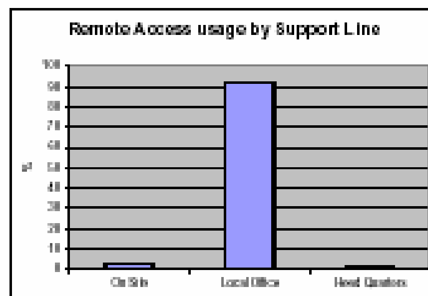
- Extensive use of Field Data has significantly reduced the time to maturity
  - 24 hrs coverage
    - every event is there
  - WW coverage
    - every machine counts
  - no 'filtering'
    - all machines are equal
    - universal processing

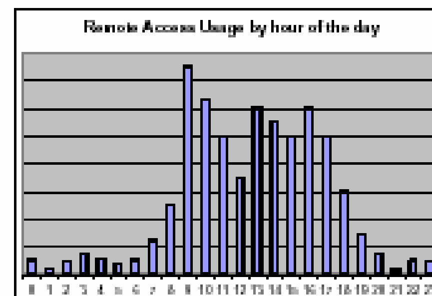


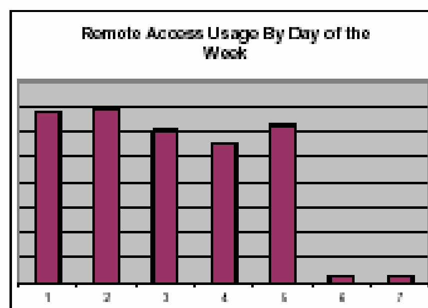
Introduction PMA

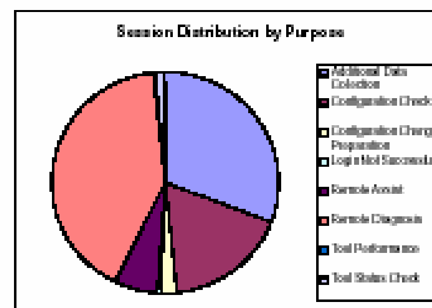
Remote Access Usage

(based on 9000 sessions/ 12.500 session hours)









Support Process Success

- Remote Access has:
  - Improved response times (ICM benefit)
  - Reduced engineer transit losses (OEM benefit)
- Automatic Data Collection has:
  - Reduced variance in Machine Performance (ICM benefit)
    - performance benchmarks are known
    - performance detractors are 'visible'
    - machine events linked to knowledge base
  - Reduced the risk (ICM benefit) and workload (OEM benefit) of data collection

/ Slide 7

Remote Access Issues

- Acceptance of e-Diagnostics within ICM (equipment owners) is growing fast
- Both parties benefit but investments a point of discussion
- Supporting different ICM solution flavours for Remote Access is a problem for ASML

/ Slide 8

Current Support Issue

- Laptop computer as service tool and data carrier discouraged by fabs
  - Complexity of machines is increasing
  - Pressure on performance increasing
- To make ASML ww knowledge available for our service engineers we need:
  - Bi-directional data flow between Fabs and ASML
  - Secure communication between applications

/ Slide 9

Directions Being Investigated

- Separate the Remote Access interface from the equipment level
- 3rd Party Connectivity Solutions
- Migration from various file formats to XML
- Migration from an informal distributed file based interface to a formal data interface
- Improve e-Diagnostics capabilities for the support and development processes

/ Slide 10

Related Developments

- TWINSCAN will have Interface A with phasing:
  - 1) webserver + http: / XML file access
  - 1a) integration in e-Diagnostics 'loop'
  - 2) authentication / authorisation
  - 3) notification facilities
- Compliance level still under evaluation

/ Slide 11

Summary

- ASML has been active with e-Diagnostics over the last 6 years
- e-Diagnostics functionality creates added value for our Customers and for ASML
- ASML sees opportunities for further service and performance improvements based on e-Diagnostics
- Developments are ongoing to realise a number of these opportunities

/ Slide 12

Effective APC/FDC Through Data Quality

John Pace
Si Automation

April 2004

Agenda

- Data Quality Background
- Data Usage
- Data Quality Problems
- Impact on Application/Product Design
- Impact on Fab – Discussion
- Closing remarks

2

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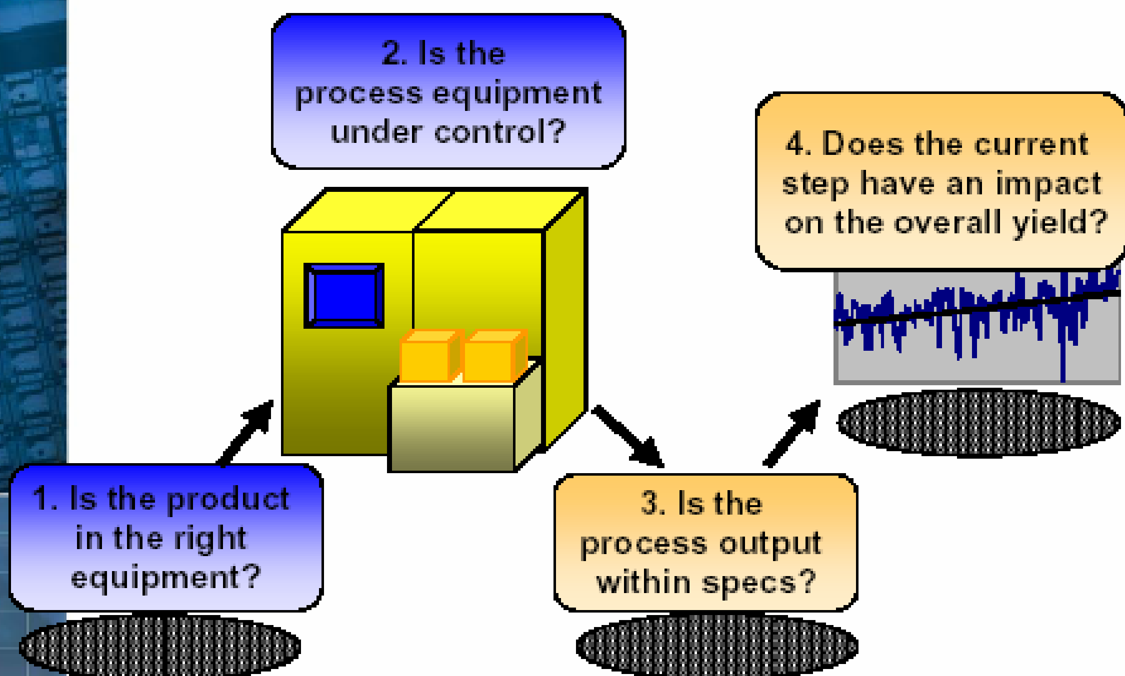
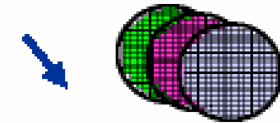
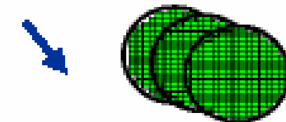
Data Quality Background

- Data and the information it contains is key to the successful operations of the tools and the Fab
- In order to insure the successful operations the data must have the "highest" quality – avail, accurate, timely…..

APC/FDC Purpose



APC/FDC Benefits

- Goal? — Equipment Control
- Why? — Scrap ↘  NPW ↘  OEE ↗
- How ? — Through APC/FDC Methodology

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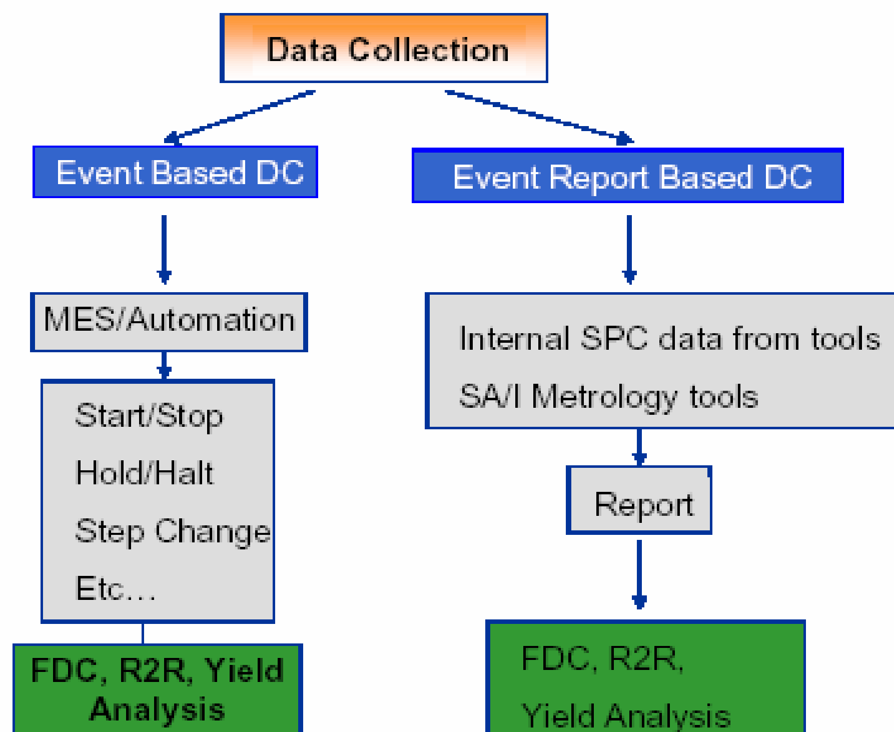
Data Collection



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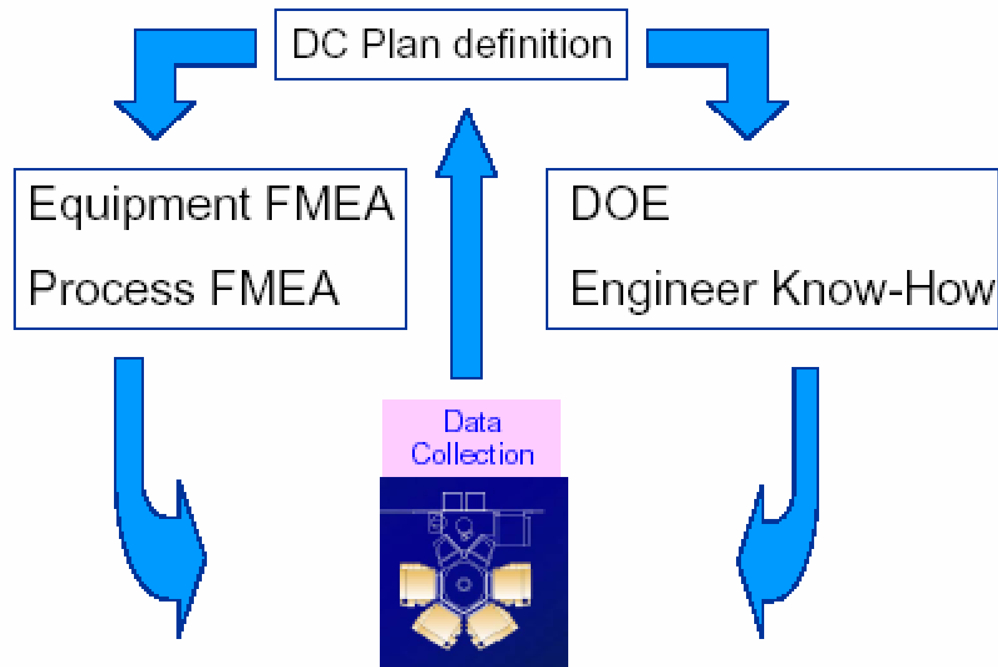
7
DC Plan Definition
What Data to collect?
Which specific step(s)?
DC Plan definition
Equipment FMEA
Process FMEA
DOE
Engineer Know-How
Data Collection
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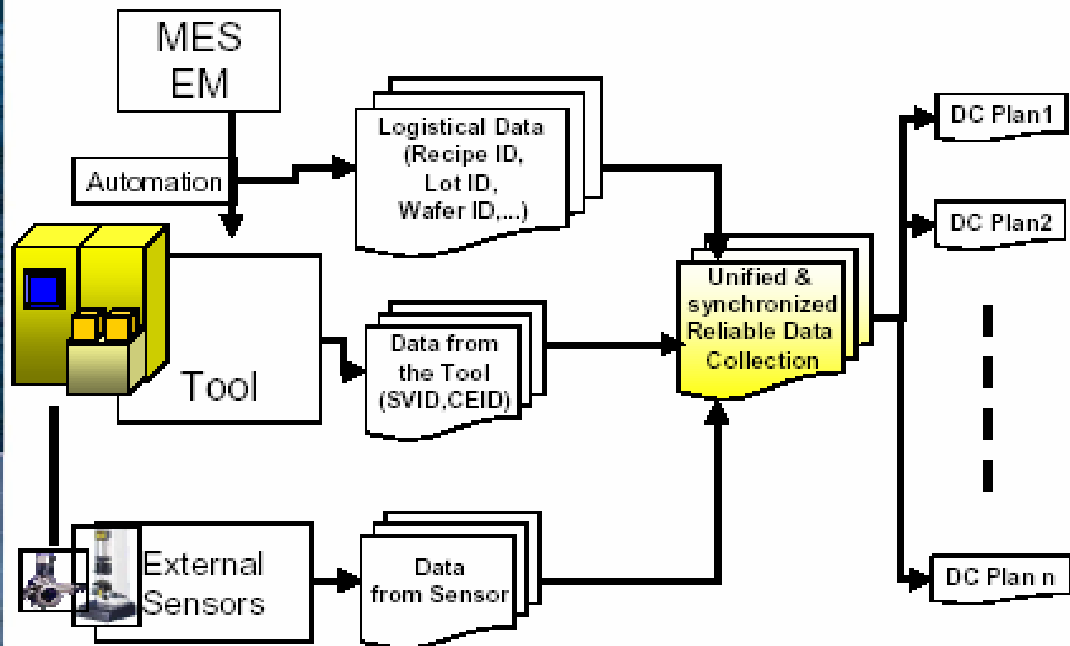
8
APC/FDC Cornerstone : Data Collection
MES
EM
Automation
Logistical Data (Recipe ID, Lot ID, Wafer ID,...)
Tool
Data from the Tool (SVID,CEID)
Unified & synchronized Reliable Data Collection
DC Plan1
DC Plan2
DC Plan n
External Sensors
Data from Sensor
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Observed Equipment Interface Problem and their Impact on APC/FDC

- Event Delays - - - Bad data synchronization, missing part of data to analyze
- Event Missing - - - Impossible to prepare/start/stop APC/FDC Strategy
- Variable Missing - - - Impossible to collect and analyzed variable (it is not hooked up)
- Logistic Variable Missing - - - Impossible to start required strategy for this context
- Sample delays - - - Induced Noise, Potential false alarms
- Secs Port - - - Hole in Data Collection because Automation messages are prioritized
- Huge DC Plan handling - - - May impact equipment throughput, or normal behavior, possible crash, in best case big delays
- StepID and Variables synchronization - - - False Alarms

9

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Another Problem

- Once you have solved the problem previously listed and are satisfied with data accuracy, freshness….. You still may have a bigger problem……..

10

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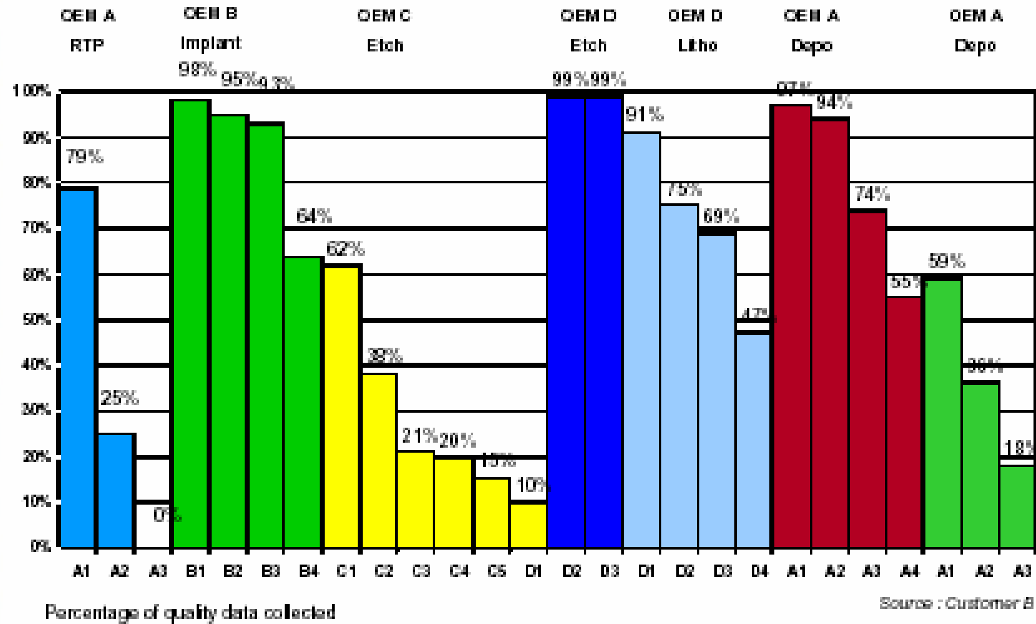
Example: Equipment DQ Performances



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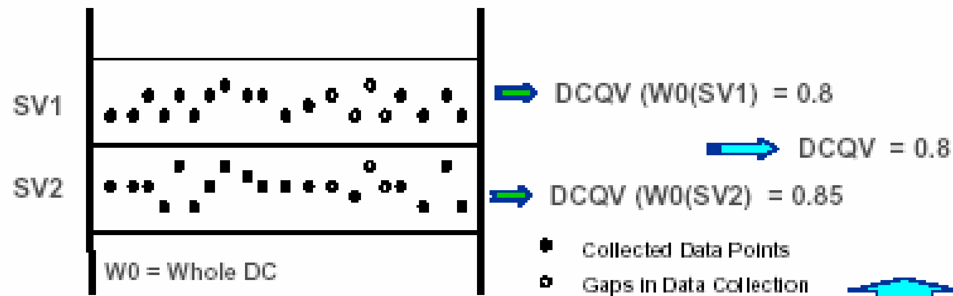
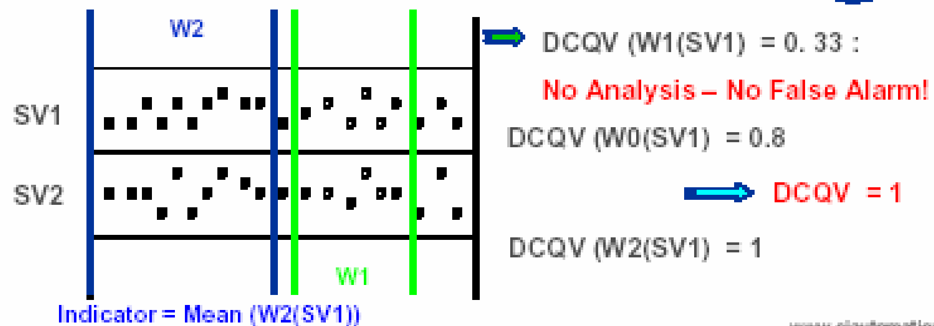
DCQV : Process or Window ?



DC Quality Value calculation for whole process

DC Quality Value calculation within selected time windows



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DCQV setting considerations

- How signal(s) is varying with time
- DoE
- Experience with calling Faults

13

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Impact on Fab

- Discussion

14

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Closing Remarks

- Data Quality is important for effective use of APC/FDC in the Fab
- Tools must provide “high” quality data
- SEMI NA Data Quality Task Force

15

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Standards Status Including Improvement Efforts

Dr. Gerhard Kleineidam

InReCon AG, Sinzing, Germany

gerhard.kleineidam@inrecon.de

20 April 2004

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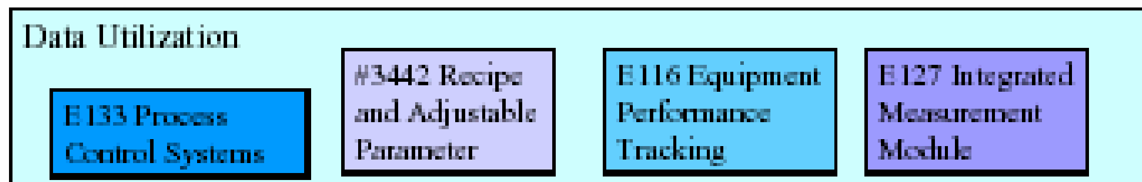
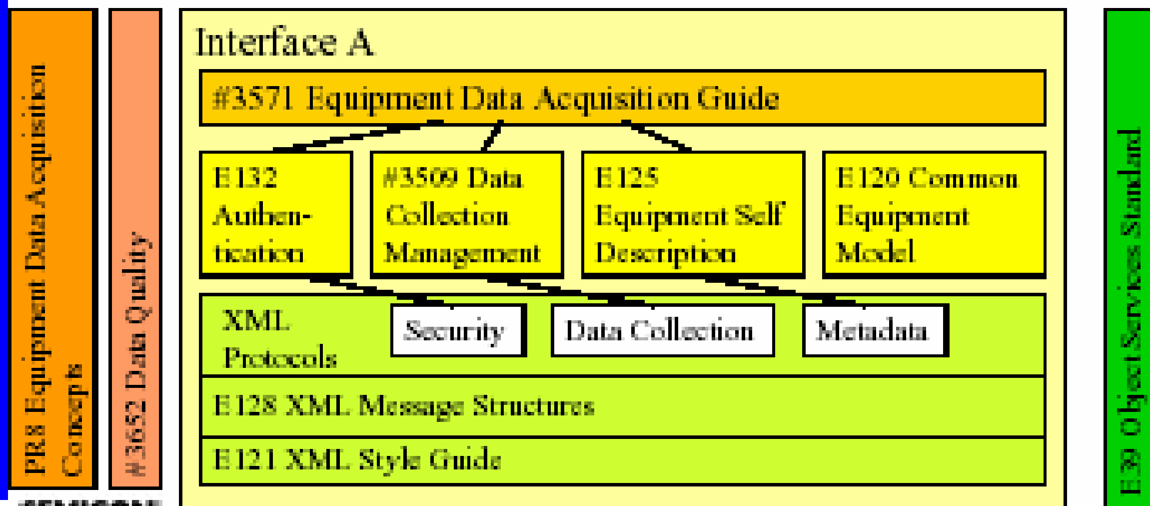
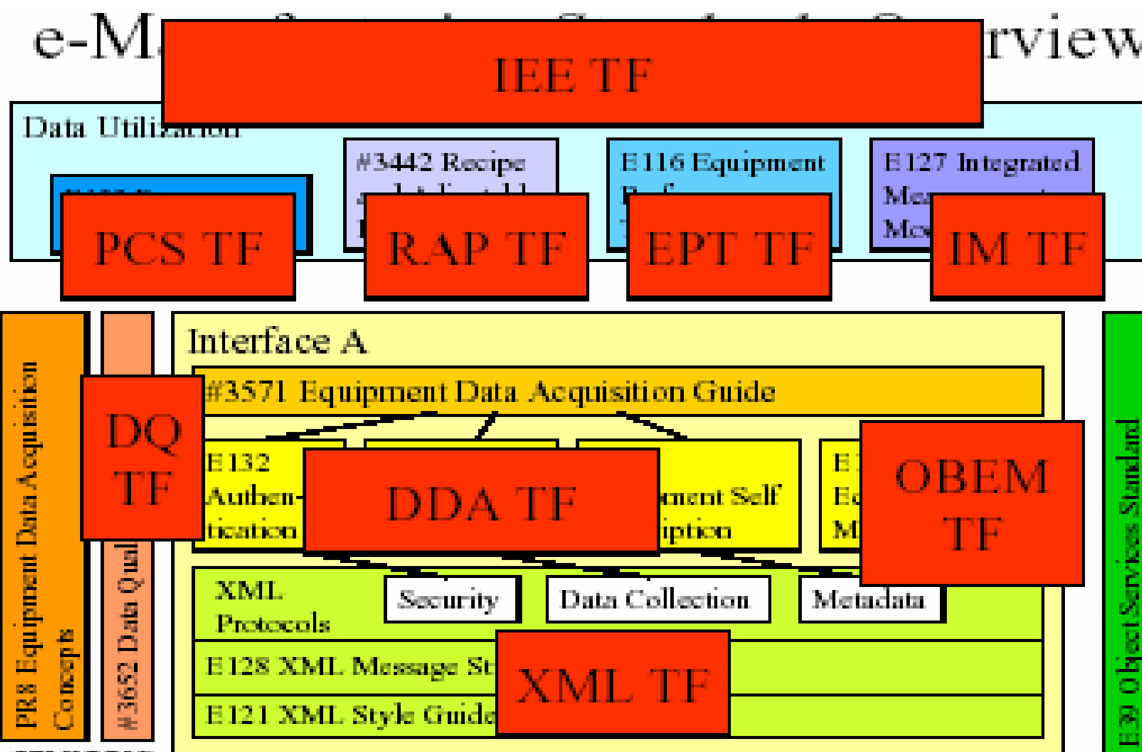
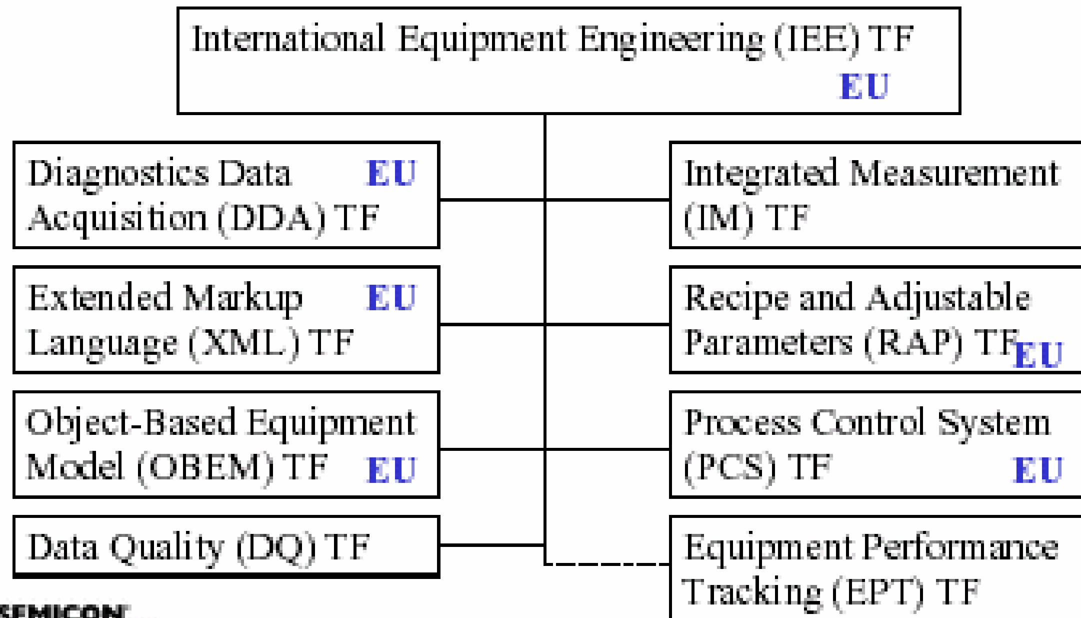
e-Manufacturing Standards Overview









Standards Status (1)

	2002	2003	2004
IEE TF			
Time Synchronisation			Re-activated 03/04
XML TF			
XML Style		E121-0303, E121-0703	
XML Message Structures		E128-0703	
Common Components			
Standard for XML			
DQ TF			
Data Quality Definition			#3652

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Standards Status (3)

OBEM TF	2002	2003	2004
Common Equipment Model		E120, E120	#3848 → E120
XML Schema			#3568 → E120.1
OBEM	E98	#3645, #3645	#3645A → Proposal to withdraw
SECS-II Mapping		#3645	#3645A → Proposal to withdraw
XML Mapping			cancelled
Object Services Standard	E39	E39	

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Standards Status (4)

PCS TF	2002	2003	2004
Automated PCS Interface			E133, #3848 → E133
PCS Integration Spec.			cancelled
RaP TF			
Recipe and Parameter Mgmt.		#3442	#3442, #3442A
Recipe Structure			Tbd after #3442 approval
IM TF			
IMM Communication		E127, #3787A	E127; #3853 → E127
SECS-II Protocol for IMM		#3730	E127.1

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Outlook

- Standards for Interface A on target to be published in 2004
- International standardization effort between USA, Japan, Europe, and Taiwan
- European e-Manufacturing TFs open for additional participants
- Other European I&C TF (SANPro) working on Sensor Actuator Network Standard for PROFInet (currently preparing yellow ballot)

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