行政院及所屬各機關出國報告

(出國類別:出席國際會議)

出席第十四屆國際半導體產業
環境安全衛生研討會

服務機關：科學工業園區管理局
職　　稱：技正
姓　　名：蔡錦郎

出國地區：韓國
出國期間：96 年 6 月 16 日至
96 年 6 月 22 日
報告日期：96 年 8 月 27 日

摘要

園區之半導體產業發展迅速，近年來半導體製程不斷的演進，從毫微米製程進入到奈米製程，晶圓的尺寸亦不斷的增加，從 6 吋、8 吋一直發展到現在的 12 吋，隨著半導體製程的演進及晶圓尺寸的增大，半導體製程機台不斷的更新，而半導體製程使用的化學品種類及數量亦不斷的增加，衍生而來的安全衛生等相關問題亦日漸複雜，藉由參加第 14 屆國際半導體產業環安衛研討會活動，以了解世界各工業先進國家之安全衛生設施與管理發展趨勢，並收集相關資料，以作為擬訂、執行相關保護勞工安全衛生計畫之參考。本屆國際半導體產業環安衛研討會活動由韓國半導體協會主辦在濟州島舉行，研討會行程分為安全衛生管理、PFC、LCA、能源管理、法令制定、環境管理、廢水管理、尾氣處理等議題進行研討，由於國際上對全球氣候變遷及溫室效應的重視，世界半導體產業協會各會員均投入了大量的人力及物力等資源從事相關議題之推動及研究工作，故本次研討會以全球氣候變遷及溫室效應等相關議題為大宗，在安全衛生管理方面，本次研討會中發表的主要議題包括奈米科技安全、健康管理、噪音危害管理及及承攬商管理等方面。

目錄

壹、目的

園區半導體產業發展迅速，隨著半導體製程的演進及晶圓尺寸增加，衍生而來的安全衛生相關問題亦日漸複雜，藉由參加第 14 屆國際半導體產業環安衛研討會活動，了解世界各工業先進國家之安全衛生設施與管理發展趨勢，並收集相關資料，以作為擬訂、執行相關保護勞工安全衛生計畫之參考，以創造勞資雙贏的工作環境。

貳、過程

本次參加研討會出國行程如下：

六月十六日　　　　　搭機抵達韓國濟州島

六月十七日至二十一日　參加第 14 屆國際半導體產業環安衛研討會

六月二十二日　　　　搭機返抵桃園機場

國際半導體產業協會(World Semiconductor Council; WSC)自西元 1994 年以來每年均舉辦國際半導體產業環安衛研討會(International Semiconductor Environment, Safety & Health Conference; ISESH)並由美國、歐洲及亞洲輪流舉辦，當輪到亞洲的時候由亞洲現有三個會員日本電子情報技術產業協會(Japan Electronics and Information Technology Industries Association; JEITA)、韓國半導體產業協會(Korea Semiconductor Industry Association; KSIA)及台灣半導體產業協會(Taiwan Semiconductor Industry Association; TSIA)輪流主辦，因此原則上台灣半導體產業協會(TSIA)每 9 年會主辦一次國際半導體產業環安衛研討會，本屆(第 14 屆)國際半導體產業環安衛研討會由韓國半導體產業協會主辦於 2007 年 6 月 17 日至 6 月 21 日在韓國濟州島舉行，台灣參加的成員包括：台灣半導體產業協會環安衛委員會技術顧問呂慶慧、力晶半導體股份有限公司總經理室顧問牟科俊、力晶半導體股份有限公司工安環保部工安課資深工程師吳鎧光、聯華電子股份有限公司風險管理暨環安/8E 安環部主任工程師鄒鄉銘、台灣積體電路製

造股份有限公司風險管理暨工安環保衛生處副理曾裕德、工業技術研究院能源與環境研究所施惠雅小姐及科學工業園區管理局勞資組技正蔡錦郎。

研討會於 6 月 17 日舉行歡迎餐會，出席與會的各國專家學者齊聚一堂，互相寒喧，研討會於 6 月 18 日上午正式開幕，首先由主辦單位韓國半導體產業協會代表及濟州自治省官員發表演說，接著由世界半導體產業協會各會員歐洲半導體產業協會(SIA in Europe)、日本電子情報技術產業協會(SIA in Japan)、韓國半導體產業協會(SIA in Korea)、美國半導體產業協會(SIA in US)及台灣半導體產業協會(SIA in Chinese Taipei)分別報告各會員近一年狀況及在環安衛方面努力成果，及安排現今半導體產業環安衛業務重點演說，力晶半導體股份有限公司總經理事顧問牟科俊代表台灣半導體產業協會上台報告，報告的主要內容為台灣半導體產業協會環安衛委員會組織變動及在環安衛方面努力的績效及現況。

隨後的研討會行程分為安全衛生管理、PFC、LCA、能源管理、法令制定、環境管理、廢水管理、尾氣處理等主題進行研討，由於國際上對全球氣候變遷及溫室效應的重視，世界半導體產業協會各會員均投入了大量的人力及物力等資源從事相關議題之推動及研究工作，故本次研討會以全球氣候變遷及溫室效應等相關議題為大宗，在安全衛

生管理方面，本次研討會中發表的主要議題包括奈米科技安全、健康管理、噪音危害管理及及承攬商管理等方面。

研討會最後一天由主辦單位安排參觀韓國能源研究機構(Korea Institute of Energy Research; KIER)(如圖一)，該機構主要負責之業務項目包括：高效率能源技術研究、能源轉換技術研究、新能源研究、再生能源研究、先進能源材料技術研究、能源政策研究及技術移轉，在聽過簡報之後參觀該機構的風力發電設備(如圖二)與太陽能發電設備(如圖三)，其中風力發電設備與台灣新竹苗栗沿海風力發電設備類似，然而值得一提的是一般人皆認為風力發電系統比其他發電系統(例如火力發電、核能發電系統)環保而且沒有污染，因此韓國政府想在濟洲島當地廣設風力發電設備，然而當地居民基於風力發電設備噪音嚴重影響居民生活品質及土地徵收等問題考量，反對政府在當地設置風力發電設備，韓國方面為了解決這樣的問題，規劃將風力發電設備安裝在近岸的海上(offshore)，雖然在海上建造風力發電設備的技術上較不易克服且造價相對昂貴，然而卻可避免風力發電設備所產生的噪音困擾居民及土地徵收使用的問題，這樣的思考邏輯及做法或許也可作為台灣方面爾後遭遇到相同問題處理時之參考。

圖一 韓國能源研究機構

圖二 風力發電設備

圖三 太陽能發電設備

參、心得

本次研討會由於國際上對全球氣候變遷及溫室效應等問題的重視，故本次研討會以相關的環境保護議題為大宗，在安全衛生管理方面，研討會中發表的議題主要包括奈米科技安全、承攬商管理及噪音危害管理及健康管理等等，茲就個人認為與園區安全衛生相關且重要的奈米科技安全與承攬商管理之議題，分述心得如下：

一、奈米科技安全

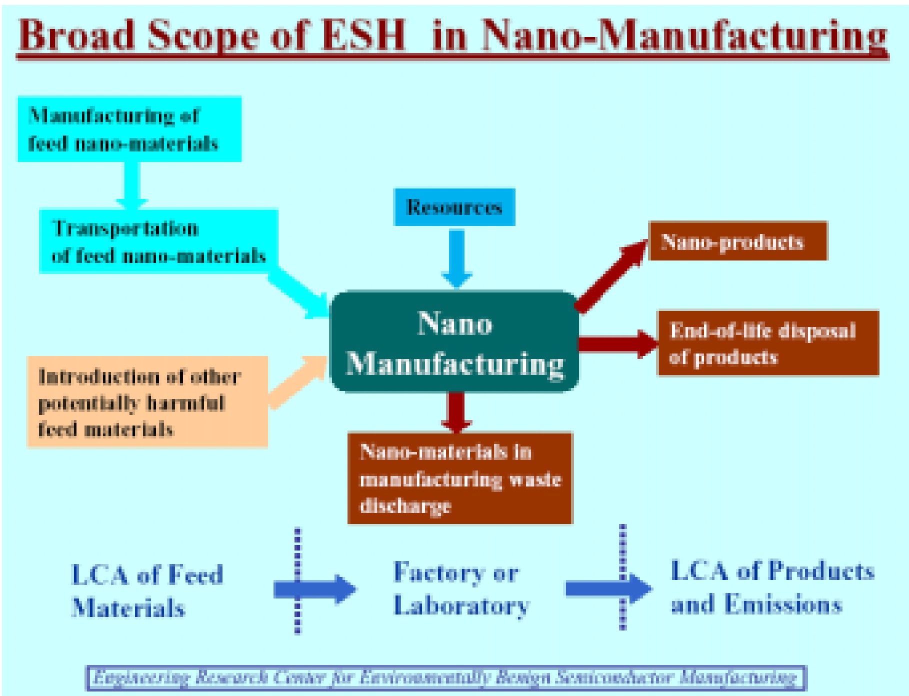
奈米科技的發展近年來受到全世界相當的矚目，其主要的原因在於量測儀器的進步，使得當物質小到一定程度時所發生的特殊現象可以被觀測或量測，過去這些奈米物質所產生的特殊現象，並不容易藉由該物質所產生的宏觀現象而察知，奈米結構一方面是一個令科學家們充滿了想像空間的神奇領域，其發展可使人類解開大自然造物的奧秘；另一方面，電子元件微小化所面臨的材料及技術瓶頸，也將因奈米科技的發展而有所突破，例如：在半導體 IC 產業中，當線徑小於 45nm 以下時，電子將會從鋁(Al)材移轉至附近的材料，因此，Al CVD 的製程將被銅製程所取代以解決電子轉移的問題。由於奈米物質具有其獨特的特性，而如何將奈米物質具有之獨特的特性，透過創意轉成實際生活上之應用，進而產生具體經濟成效，是現今所有科技發展先進國家重視奈米科技最主要因素之一。

奈米科技為人類帶來無窮的想像和希望，目前奈米科技已成為最

具有潛力的新興科技，科學家們利用奈米技術發展更輕、更強韌及具有特殊性質的材料來造福人類，但是在此同時，奈米物質或奈米科技是否會為人類帶來新的風險，以及奈米科技或奈米材料對於人體或環境是否會帶來危害，也是極需要慎重考量和評估的課題，奈米物質的微小化造成其物性、化性、活性改變，進而對於人體所可能造成之安全與健康上危害也將隨之改變，雖然目前仍缺乏奈米微粒之毒理、安全性、暴露之完整評估，但根據奈米物質有較大的表面積，奈米微粒可能穿透人體之屏蔽系統(如細胞膜、有傷口皮膚等)，因此對於奈米物質之暴露問題、作業安全、沉積吸收、及毒性可能都不相同，然而目前在缺乏相關奈米材料所帶來之可能危險性的資訊下，奈米科技工作場所之工作人員可能以傳統安全與衛生的知識及管理方式去處置這些物質，而那些比細胞還小的奈米顆粒，是否會對於暴露在這樣工作環境下的研究人員或工作人員構成生命上的危害，不得而知。因此隨著奈米科技的發展，對於奈米物質之暴露危害評估與控制防護，也應該被予以重視。

從環境安全衛生觀點上，半導體奈米產品流程可被概分為三個主要程序：奈米原料的供給、製造工廠或實驗室製造、奈米產品及最終處理，其相互關係詳如圖四所示，而奈米產品在製造過程中須考量的環境安全衛生問題主要有以下幾點：1. 奈米產品在製造過程使用奈米粒子原料，作業人員可能暴露在奈米粒子環境之中，以及奈米粒子

可能透過工廠廢水及排氣系統排放到環境中。2. 奈米製程將對資源的使用造成衝擊，奈米製程將增加水資源、能量及化學品使用量。3. 奈米科技製程增加新物質使用，例如新的產品材料、新的製程流體等等，在 1980 年代的時候半導體製程使用了 11 種化學元素，到了 1990 年代增加到 15 種化學元素，到了 2000 年已使用超過 60 種化學元素，使用化學品數量的增加對於環境安全衛生的衝擊及風險就越高。4. 對於環境衝擊的積極面，奈米科技提供環境安全衛生科技進步的機會，拜奈米科技之賜將有機會逐步淘汰那些被根深蒂固使用在現今製程而對環境安全衛生會造成問題的材料，例如；PFCs 以及 PFOS；也將有機會將逐步淘汰目前對環境安全衛生會造成問題的製程，取而代之的是對環境安全衛生更友善的製程。



圖四

二、承攬商管理

園區的半導體產品的製造過程中涉及複雜技術且使用為數眾多具有窒息性、助燃性、可燃性、自燃性、毒性及腐蝕性等高危險性的化學品與特殊氣體，然而這些高危險性的化學品與特殊氣體在儲存、搬運、使用及廢棄的過程中需要良好的安全管理技術加以控制，否則稍有不慎即可能造成嚴重的災害事故，因此，園區半導體廠在建造及營運過程中需仰賴各種不同專業的整合，如土木、營建、水電施工、管線配置、設備安裝、設施維護、歲修等等，而各階段都需要不同承攬商員工的參與才得以順利完成並持續營運，然而，由於承攬商作業人員的良莠不齊，或對於原事業單位工作環境的不熟悉，或作業人員以本身認知經驗來施工，或承攬商雇主漠視、或事業單位未建構完善的安全衛生管理制度等等，導致承攬商施工意外事件頻傳，造成原事業單位重大損失。例如：園區某半導體廠曾因承攬商更換化學氣體管路作業時，因承攬商勞工誤切氣體管路造成多名勞工送醫檢查之重大工安事故，使整個化學氣體管路更換作業被迫停止，更由於媒體的報導，受到社會大眾的矚目以及中央機關的關心，影響公司形象甚巨。由此可知承攬商安全管理之重要性。

我國勞工安全衛生法即於第 17 條及第 18 條分別規定：「事業單位以其事業之全部或一部分交付承攬時，應於事前告知該承攬人有關其事業工作環境、危害因素暨本法及有關安全衛生規定應採取之措

施」及「事業單位與承攬人、再承攬人分別僱用勞工共同作業時，為防止職業災害，原事業單位應採取左列必要措施：1.設置協議組織，並指定工作場所負責人，擔任指揮及協調之工作。2.工作之連繫與調整。3.工作場所之巡視。4.相關承攬事業間之安全衛生教育之指導及協助。5.其他為防止職業災害之必要事項。」，其立法之目的即在規範事業單位將其事業之一部分交付承攬商承攬時，應確實做好承攬商安全管理，以防止災害事故之發生，因此，事業單位如何依循法規之規定建立一套良好的承攬商管理制度，以減低承攬商工安事故是園區半導體廠首要之務。

一般來說，園區半導體廠承攬商施工作業項目繁多，礙於原事業單位人力有限，承攬商安全管理必須採行重點作業管理及承攬商自主管理兩種方式相互配合執行方可奏效，重點作業管理主要可將高架、局限空間、感電、火災及危害性氣體/化學品外洩等可能會造成人員傷亡或重大財物損失的作業項目定義為高風險作業，而將可能會造成系統停機、生產中斷之作業項目定義次高風險作業，並根據不同作業項目或行為，事先明確定義承攬商施工人員必須具備資格及施工時所需採取的安全防護措施及管制程序；而在承攬商自主管理部分，原事業單位可要求承接高風險工程的承攬商建構國際認可的安全衛生管理系統且經過驗證機構驗證合格後，該承攬商方可取得資格進行投標，藉此加重承攬商自主管理的責任感，進而為整個業界提昇承攬商

的安全文化與技能素質，另外承攬商施工人員也必須先完成高風險工程作業的技能認證後方可進場施作。

實務經驗上也證明了只要原事業單位確實執行重點作業管理及承攬商自主管理，承攬商所造成的意外事故件數即有明顯下降，因此在承攬商安全管理上，原事業單位扮演著關鍵的角色。

肆、建議

一、 國際半導體產業環境安全衛生研討會是由世界半導體協會主導的一個全球性的環安衛論壇，其所研討的主題都是全球半導體產業在環境安全衛生方面最關注的問題，而竹科的半導體廠商在國際半導體產業中亦扮演著重要的地位，因此我們應該積極參與該研討會等活動，以適時了解全球半導體產業最新環安衛趨勢，以作為園區擬訂與執行相關保護勞工安全衛生計畫之參考。

二、 由於奈米物質具有其獨特的特性，透過創意轉成實際生活上之應用，進而產生具體經濟成效，另外，半導體電子元件微小化所面臨的材料及技術瓶頸，也將因奈米科技的發展而有所突破，但是在此同時，奈米科技安全也將成為重要的課題，建議管理局人才培育課程可考量加入此類課程，提升園區奈米科技安全管理能力。

三、 園區高科技產業的運轉，需仰賴園區事業單位與承攬商的共同參與才得以順利完成並持續營運，參考本次研討會研討資料內容，提升承攬商安全衛生管理能力，可有效降低承攬商施工意外之發生，因此未來管理局除輔導園區廠商通過政府或國際上認可的安全衛生管理系統之驗證外，亦可輔導園區承攬商通過類似管理系統之驗證。

伍、附錄

一、 第九屆國際半導體產業環安衛研討會行程表

二、 ISESH '07 安全衛生重要議題簡報資料

1. Farhang Shadman, "Environmental Challenges and Opportunities in Nano-Scale Manufacturing of Future Electronics," SRC/Sematech Engineering Research Center for Environmentally Benign Semiconductor Manufacturing of Future Electronics.
2. Y.D. Tzeng, "Contractor Self-Management in TSMC," Taiwan Semiconductor Manufacturing Company (TSMC).

IESEH '07

14th Annual Conference

Jeju Island, KOREA

17-21 June 2007

International

Semiconductor

Environment,

Safety &

Health Conference

Hosted by

Korea Semiconductor Industry Association

#107 Yangjae-dong, Seocho-ku, Seoul, Korea 137-130
Tel: +82-2-570-5234 / Fax: +82-2-577-1719
steve@ksia.or.kr
www.ksia.or.kr

Schedule-at-a-glance

WHEN	WHAT	WHERE
Sunday 17 June	Check-in	
17:30-19:00	Conference Check-in	
18:45-21:00	Welcome Dinner	Halla
Monday 18 June	ISESH Conference	
08:00-08:50	Conference Check-in	
09:00-12:30	ISESH Plenary Session	Lotus Hall
12:40-13:50	Lunch (Standing Buffet)	Halla
14:00-18:00	Afternoon Session (A&B)	
19:00-21:00	Official ISESH Dinner	Pool Side
Tuesday 19 June	ISESH Conference	
09:00-12:00	Morning Session (A&B)	
12:00-13:40	Lunch (Standing Buffet)	Halla
14:00-18:00	Afternoon Session	
19:00-21:30	Dinner	Hotel lobby at 18:30
Wednesday 20 June	ISESH Conference	
09:00-12:00	Morning Session	
12:00-13:40	Lunch (Japanese Lunch Box)	Halla
14:00-18:00	Afternoon Session	
19:00-21:00	Dinner (Buffet)	Halla
Thursday 21 June	Additional day	
09:00-12:00	Technical Tour	Hotel lobby at 09:20
12:00-13:00	Lunch (Lunch Box)	

MONDAY 18 JUNE

ISESH Plenary Session
Official Opening Address & Keynote Speakers Session
Lotus

08:00-08:50
CONFERENCE CHECK-IN
ISESH Office · Ora

09:00-10:15
INTRODUCTION TO ISESH 2007 (5")
Dr. Ho Song HWANG / KSIA ESH Chair - SAMSUNG

OFFICIAL ISESH 2007 CONFERENCE OPENING REMARKS (10")
Dr. Doug Young JOO / KSIA Vice Chairman & CEO

OFFICIAL ISESH 2007 CONFERENCE OPENING REMARKS (10")
Tae Hwan KIM / Governor of Jeju Special Self-governing Province

REGIONAL ASSOCIATION ESH UPDATES (50")
SIA In Europe · SIA in Japan · SIA in Korea ·
SIA In US · SIA in China Taipei

10:15-10:30
Coffee Break

10:30-12:30
KEYNOTE SPEAKERS SESSION

Prof. Young Sang Cho
Korea Institute of Science and Technology
- Cu issues regarding water quality regulations in Korea

Prof. Farhang Shadman
Director of SRC/Sematech Center for Environmentally Benign Semiconductor Manufacturing
Regents Professor (Chemical Engineering; Optical Sciences)
The University of Arizona
- Environmental Challenges and Opportunities in Nano-Scale Manufacturing of Future Electronics

Dr. Seung Ki Chae
Director of SAMSUNG
- Challenges of ESH in the Semiconductor Fabrication

12:40-13:50
Lunch (Standing Buffet) · Halla

MONDAY 18 JUNE
Afternoon Session A

14:00-15:30
Modelling China's Semiconductor Industry PFC Emissions and Drafting A Roadmap for Climate Protection
Scott C. Bartos / U.S. Environmental Protection Agency

Specially Designed Abatement Tools for Fliorine Compounds Used in Electronic devices Manufacturing
Tatsuro BEPPU / Kanken-Techno Co., Ltd.

Investigations of diluted F2 for CVD/ALD chamber clean as an environmental friendly replacement of NF3
Michael Pittroff / Solvay Fluor GmbH, Hannover, Germany
Solvay Fluor Korea, Seoul, South Korea

15:30-16:00
Coffee Break

16:00-18:00
PFC Reductions and The Potential to Generate Emission Reduction Credits
Seth Baruch / Qualitytonnes

PFC verifying Process for Taiwan Semiconductor Industries
Ching-Hui Lu / ITRI

Alternative Chemistry for High-Efficiency, Low-GWP
Jin Ho Lee / Hynix

The Guideline II : Measurement methods for PFCs Emissions
Takayuki Ohgoshi / NEC Electronics Corporation

19:00-21:00
Official ISESH Conference Dinner (Poolside Buffet)

MONDAY 18 JUNE
Afternoon Session B

14:00-15:30
Development of Decontamination Declaration System for the Wet Station Transportation
Huyn Jin Kang / SAMSUNG ELECTRONICS CO., LTD

Case study of cleanroom air quality improvement : Isopropanol (IPA)reduction
Y L Jen / Winbond Electronics Corp.

Health care management
Jung Hoon Lee / MagnaChip

15:30-16:00
Coffee Break

16:00-18:00
The Decomposition of a Photo Acid Generator (PAG) During the Photolithography Process
Basil Falcone / JSR Micro, Inc

PFOS: Global Regulations and Impact to the Semiconductor Industry
Tim S. Yeakley / Texas Instruments, Inc

Experimental Study of Gas Dispersion Inside a Cleanroom
Hui-Ya Shih / Energy and Environment Research Laboratories, Industrial Technology Research Institute

Noise Risk In Semiconductor Factory
Kai-Kuang Wu / Powerchip Semiconductor Corp.

19:00-21:00
Official ISESH Conference Dinner (Poolside Buffet)

TUESDAY 19 JUNE
Morning Session A

09:00-10:30
Semiconductor Industry and CDM Project
Song Taek Lim / Ecoeye

The Optimization Method and Automatic Technology in PFC Measurement
Satoshi Nitta / Otsuka Electronics., Ltd

The Evaluation and Development of CVD Chamber Cleaning System
Akira Sekiya / National Institute of Advanced Industrial Science and Technology (AIST)

10:30-11:00
Coffee Break

11:00-12:00
Update of EPSON Method for PFC Easy Measurement Using FT-IR
Isamu NAMOSE / Seiko Epson Corporation

Hybrid type PFC Abatement System
Hyuk-Soo Lee / MAT

12:00-13:40
Lunch (Standing Buffet) · Halla

TUESDAY 19 JUNE

Morning Session B

09:00-10:30

The Outline of "LCI CALCULATING PROGRAM" for Integrated Circuits and Its Verification
Akio Gotoh / Sharp Corporation

The Impact of Si Chip and Its Fabrication Technology on LCI Calculation of Semiconductor Products
Junichi Aoyama / Sony Corporation

Exaple "LCI" Calculation of Semiconductor Devices, Used for Video Camera, Those Mounted on The Printed Wired Board
Akio Gotoh / Sharp Corporation

10:30-11:00

Coffee Break

11:00-12:00

JEITA STD. Logic Process Modeling and Application 4
Nobuo Sasayama / Sony Corporation

LCA
Wansoo Huh / Soongsil University

12:00-13:40

Lunch (Standing Buffet) · Halla

TUESDAY 19 JUNE
Afternoon Session

14:00-15:30
The CO_2 Reduction of The Cold Heat Source Facilities
Mikio Matsuki / OKI environment technologies inc.

KSIA's Energy Saving Activities
Ho Seon Lim / Hynix

Achieving Superior Fab Energy Performance Requires Challenging the Status Quo
Phill Naughton / Sematech

15:30-16:00
Coffee Break

16:00-18:00
Electrical Power Conservation at FAIRCHILD SEMICONDUCTOR'S Mountaintop Wafer Fabrication Facility
Sang Soon Moon / Fairchild Semiconductor

The waste heat recycling from VOCs
C.L. Chen / Vanguard Facilities Engineering

JEITA Collaboration Activity Together with Other Industrial Association for Energy Saving
Yasuo Iizuka / JEITA

The action of PFOS issue in Japan
Imai Osamu / FUJITSU LIMITED

19:00-21:30
Korean Restaurant
Meet in Hotel lobby at 18:30

WEDNESDAY 20 JUNE
Morning Session

09:00-10:30
Introduction of "The Act for Resource Recycling of Electrical/Electronic Products and Automobiles (Korea RoHS, ELV)"
Junsik Youn / Ecofrontier Co

The Role of a Trade Association in Addressing Global ESH Issues
Chuck Fraust / Semiconductor Industry Association in the United States

Environmental Product Information of SAMSUNG
Hyun Jung Lim / SAMSUNG ELECTRONICS CO., LTD

10:30-11:00
Coffee Break

11:00-12:00
Power Semiconductors State-of-the-art and Future Development Trends
Leo Lorenz / Infineon Technologies

Contractor Self-management in TSMC
Y.D.Tzeng / TSMC

12:00-13:40
Lunch (Japanese Lunch Box) · Halla

WEDNESDAY 20 JUNE
Afternoon Session

14:00-15:30

One Example of Risk Management and Organofluoric Compounds Wastewater Treatment
Kazuyuki Yamasaki / SHARP Corp.

Electrochemical Treatment Process for Semiconductor Nitrogen Wastewater
Kyu-Won Hwang / SAMSUNG ELECTRONICS CO., LTD

ESH Improvement on UPW Producing Process
Daeyong Roh / SAMSUNG ELECTRONICS CO., LTD

15:30-16:00

Coffee Break

16:00-18:00

TMAH Waste Water Treatment System
Young Il Kim / Hynix

Recovery of Copper from Process Solutions Using the Rotating Electrode Technology
Danielle Miousse / Global Ionix Inc

Odor Reduction Project in Samsung
Kyungah Kim / SAMSUNG ELECTRONICS CO., LTD

Identifying and Reduction Nuisance Odor Around a Semiconductor FAB
Hsiang-Ming (Albu) Tsou / United Microelectronic Corp

19:00-21:00

Dinner (Buffet) · Halla

THURSDAY 21JUNE
Technical Tour

Programme

09:20	Meet Hotel Lobby
09:30	Leave The Shilla by Bus
11:00	Arrive at HANGWON Wind Power Plant Complex
11:00-11:10	Toured by bus
11:20	Arrive at New & Renewable Energy Research in Jeju
11:20-12:00	Presentation and Tour of Facilities
12:00	Finish tour
12:00-13:00	Lunch (Lunch Box)
14:00	Return to Hotel

HOTEL MAP

Shilla Hotel-Ground Floor

GENERAL INFORMATION

HOTEL ACCOMMODATION

Hotel address :
Address: 3039-3, Saekdal-dong, Seogwipo-si, Jeju-do, 697-130 Korea
Tel: 82-2-2230-3685 / Fax : 82-2-2230-3687
www.shilla.net/jeju

Contact person : Candy chang

CURRENCY

Won : Korean won
You can exchange euros, dollars, yens and at the Shilla's Front Desk. There is also a bank outside the hotel .
You can find banks at the airport banks.

INTERNET

Special 25%-discount for ISESH delegates
The Hotel shilla is equipped with High Speed wired Internet Access in all rooms (ADSL is charged at per day).

WIFI (wireless) internet access in the Hotel Lobby, Business Centre, Terrace Restaurant & the Bay View area.

OTHER

ISESH payment - payment on KSIA's account :
Those who require payment receipts for the conference fee should contact the ISESH office (room).

Dress code :
Business casual for Monday 18th. Casual for all other events.

About Jeju :
http://english.jeju.go.kr/contents

Breakfast :
From 07:00, included in room rate

SRC/Sematech
Engineering Research Center for
Environmentally Benign Semiconductor Manufacturing

Environmental Challenges and Opportunities in Nano-Scale Manufacturing of Future Electronics

14th Annual Meeting of ISESH
Jeju, Korea
June 2007

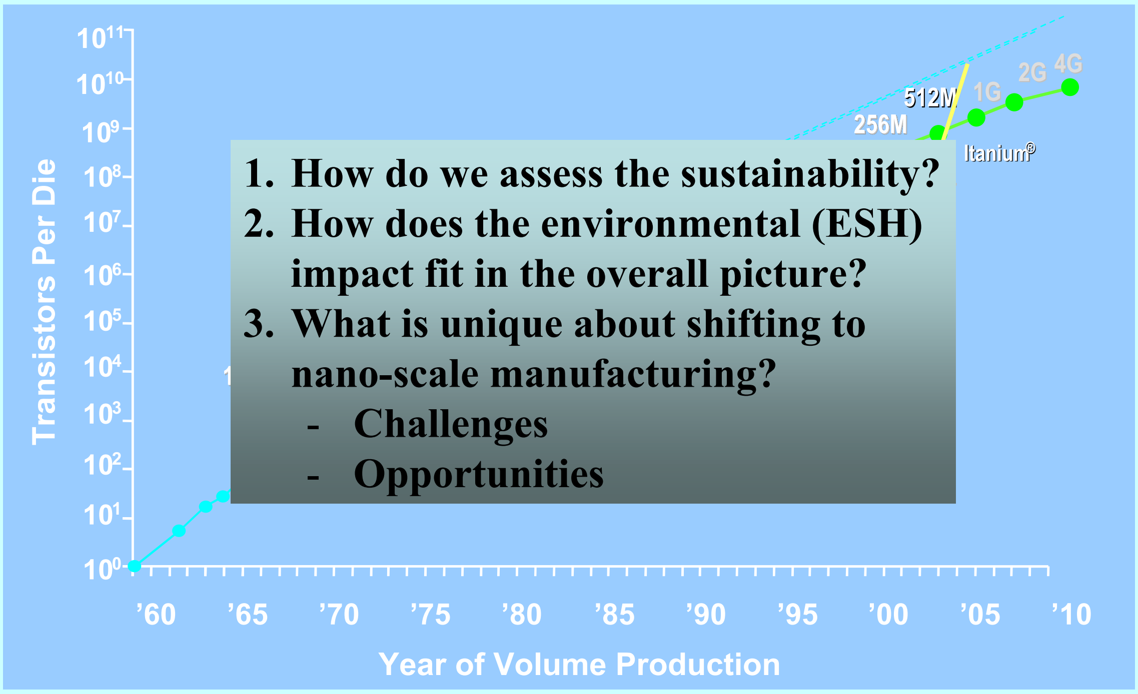
ERC Member Institutions

- University of Arizona
- MIT
- Stanford University
- UC Berkeley

Founders 1996

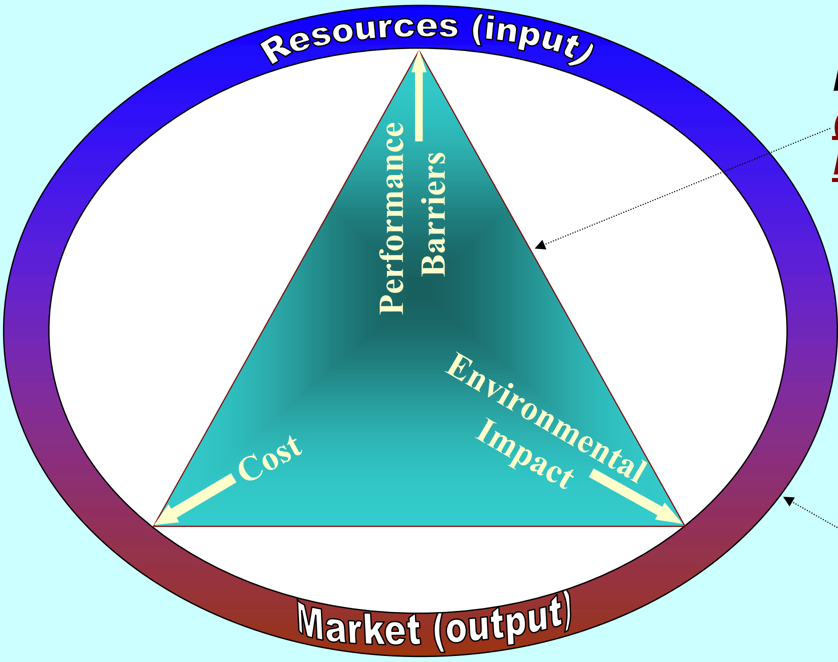
- Cornell University (1998 -)
- Arizona State University (1998 - 2003)
- University of Maryland (1999-2003)
- Purdue University (2003 -)
- Tufts University (2005 -)
- Columbia University (April 2006 -)

Sustainability of Moor's Law



1. How do we assess the sustainability?
2. How does the environmental (ESH) impact fit in the overall picture?
3. What is unique about shifting to nano-scale manufacturing?
   - Challenges
   - Opportunities

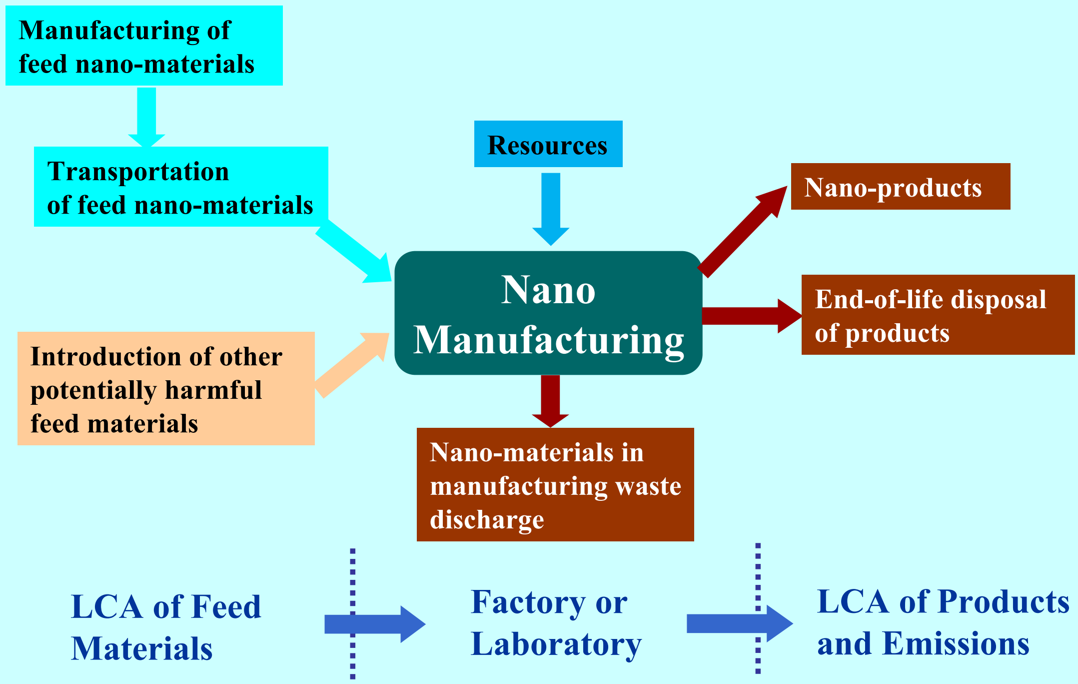
Sustainable Industry



Industry Footprint
(Manufacturing Burden)

Sustainability Boundary

Broad Scope of ESH in Nano-Manufacturing



ESH Aspects of Nano-Manufacturing

1. Nano-Particles in Manufacturing
    - Workers exposure to nano-particles in the fabs
    - Emission of nano-particles through fab waste streams
2. Impact on Resource Utilization
    - Increase is water, energy, and chemical usage
3. Introduction of New Materials
    - New device materials, new processing fluids, etc.
4. Positive Environmental Impact
    - Opportunities for major ESH gain

Facts and Fictions about Nano-Particles

- Research on nano-particles is needed; however, it is only one factor compared to far more critical sustainability issues of nano-manufacturing.
- Our environment is full of natural and man-made nano-particles. Examples are wide variety of man-made carbon nano-particles, various macromolecules, and atmospheric aerosols.

Functionalized Fabricated Nano-Particles

New name for some old materials

Aerosil = fumed SiO_2

Particle size:

4-20 *milli-micron* (nanometers)

New additive for coating industry

Colorants & Coatings

(Farbe & Lack Journal; April 1949)

Engineering Research Center for Environmentally Benign Semiconductor Manufacturing

ESH Impact of Nano-Particles

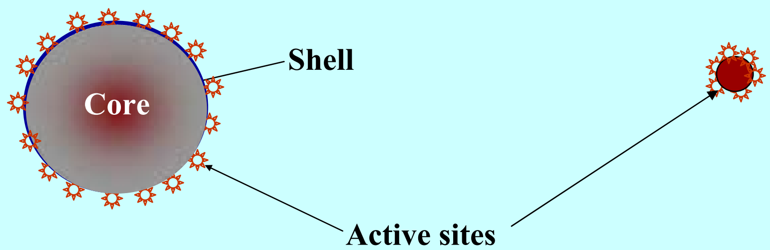
- **Effect of nano-particles and macro-molecules on biological systems has been the subject of years of extensive research.**
- **Primary effect is due to interactions of particle surface with other contaminants. *Therefore, study of nano-particles without knowing and considering the process environment around them would result in confusing and irrelevant conclusions.***

Nano-Particles in CMP Process

Two types of CMP nano-particles:

Primary Nano-Particles
(engineered particles; 5-90nm)

Secondary Nano-Particles
(very active surface; <10nm)



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Other Applications and Sources of Nano-Particles

- **Nano-particles of porogens used in deposition of porous low-k films (a current ERC project)**
- **Nano-droplets in sprays**
- **Aerosols formed in vents and in cooling towers due to chemical reactions in vapor phase (a graduated ERC project)**
- **Nano-tubes and nano-wires; potential release and handling issues if fabricated ex-situ and transported.**

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ESH Aspects of Nano-Manufacturing

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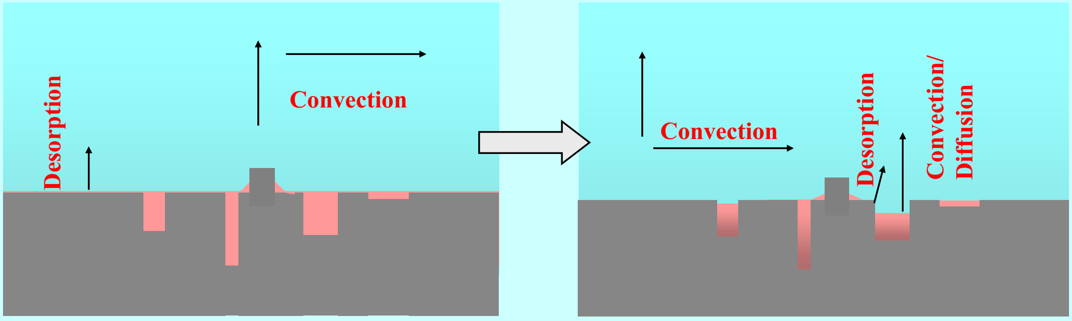
Engineering Research Center for Environmentally Benign Semiconductor Manufacturing

Issues in Cleaning of Nano-Structures

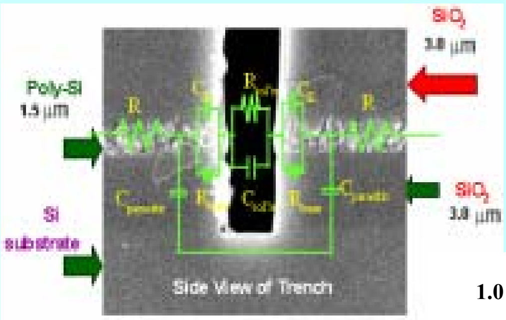


Mechanism	Time Scale	Flow Effect
Boundary Diffusion	$d^2/D \sim 10$ s	Indirect, mild
Convection	$d/u \sim 1\text{-}3$ s	Direct, strong
Desorption	$1/k_d \sim 0 - 10^5$ s	No effect

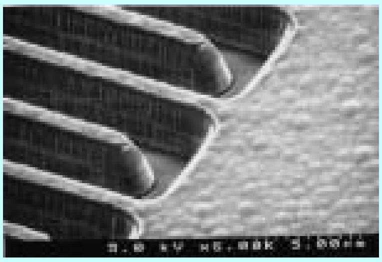
Needs:
- New real-time metrology
- New cleaning chemistries

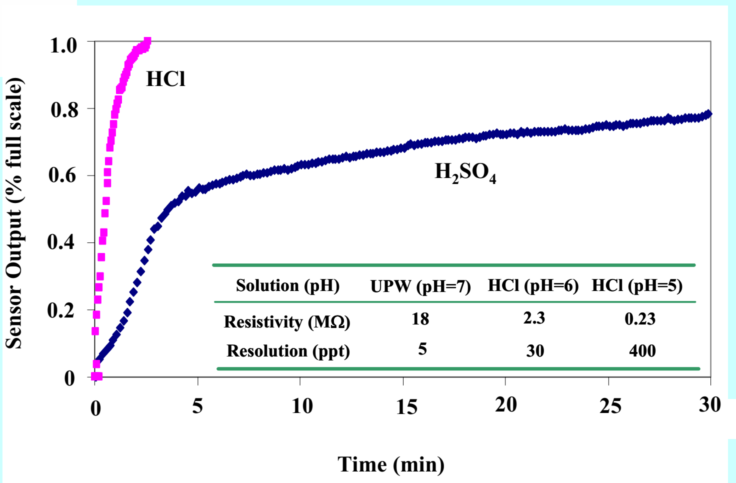
Metrology Need: Real-Time and On-line Process Control

Farhang Shadman (UA), Bert Vermeire (ASU)

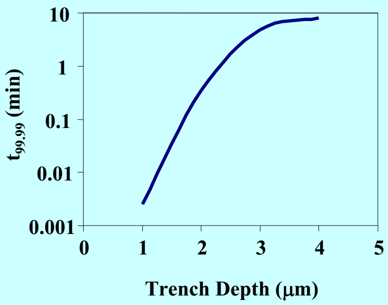


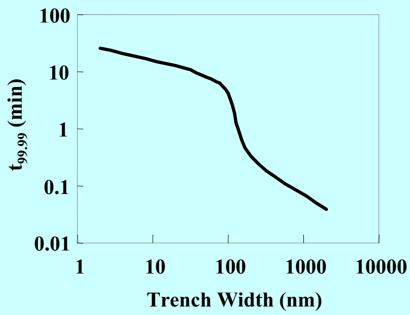
Electro-Chemical Residue Sensor (ECRS)





Cleaning Challenges in Nano-Manufacturing

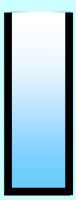


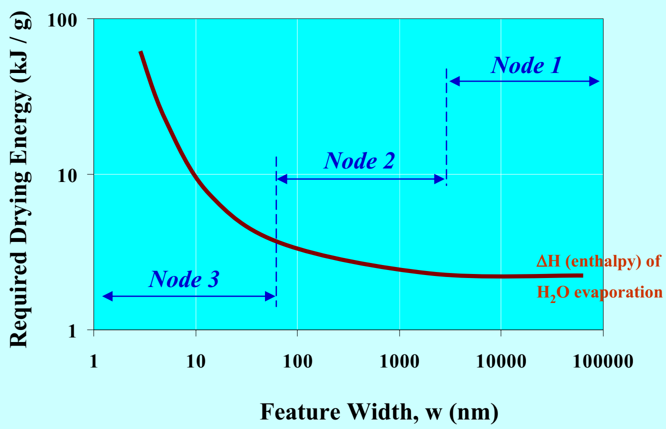


Increase in Water Usage

- Change in transport mechanisms for cleaning liquid and by-products
- More activated processes due to strong surface interactions
- Surface charge effects
- More issues with interfacial contamination (due to high surface to volume ratio)
- More processing steps
- More issues with drying and surface conditioning

Drying Challenges in Nano-Manufacturing



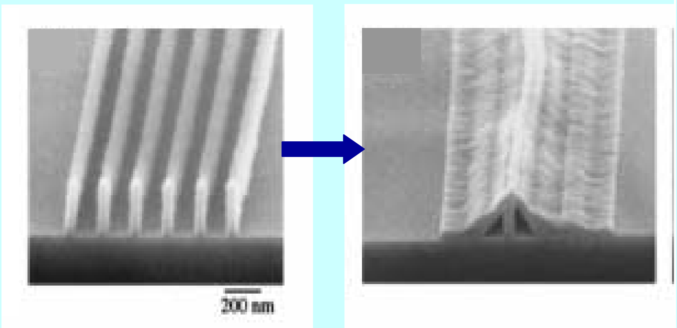


Mechanisms:

- *Node 1*: Axial drying, controlled by feature depth
- *Node 2*: Radial drying, controlled by feature width
- *Node 3*: Activated desorption, controlled by surface charge and related field effect in nano-structures

Drying Challenges in Nano-Manufacturing

- **Undesirable adhesion (sticking, agglomeration) of nano-particles, nano-fibers, and other nano-structures.**
- **Pattern collapse due to surface tension**



- **Potential solution: Fluids with high diffusivity and low surface tension (e.g. supercritical CO_2)**

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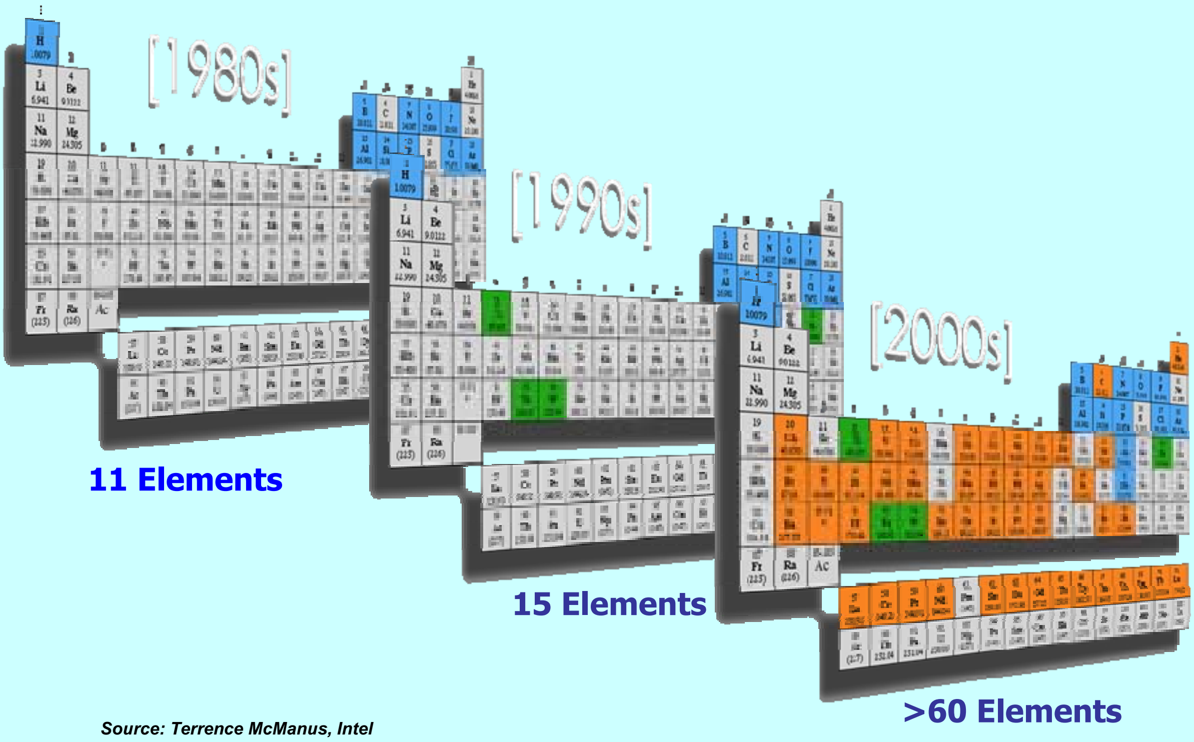
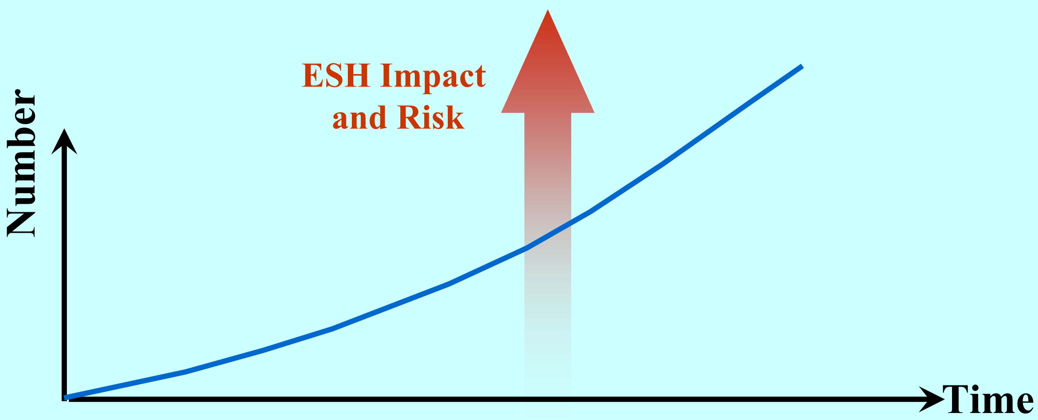
Engineering Research Center for Environmentally Benign Semiconductor Manufacturing

Introduction of New Materials

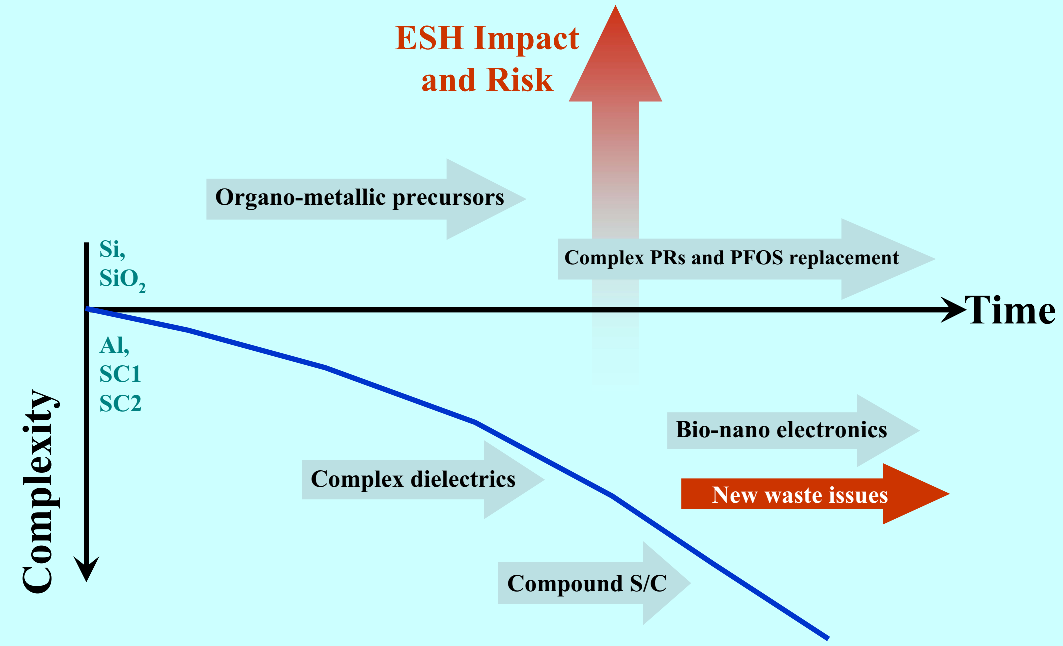


Source: Terrence McManus, Intel

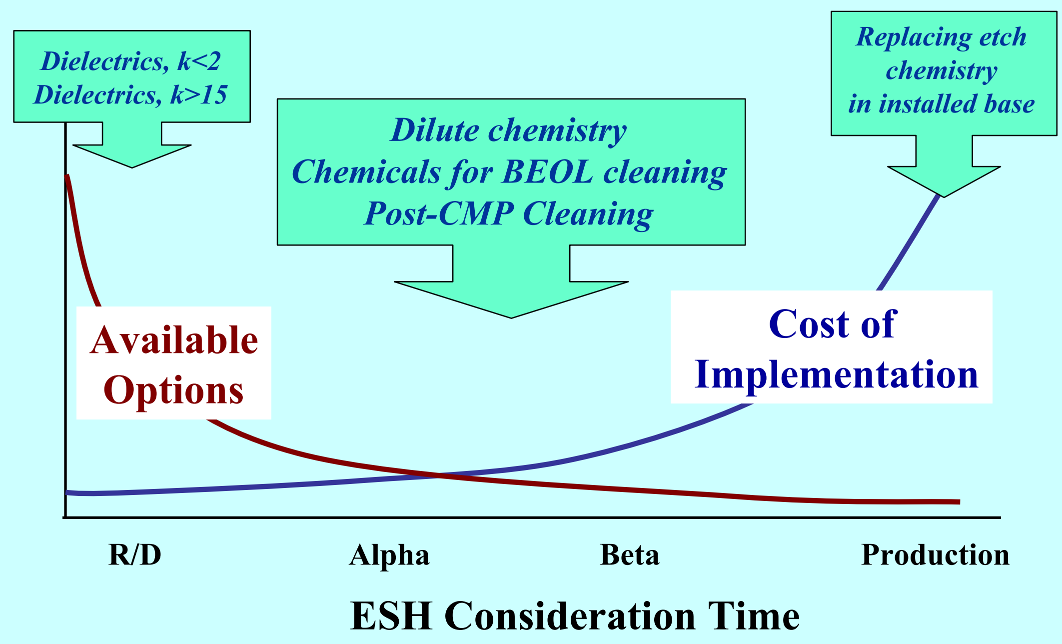
Introduction of New Materials



Introduction of New Materials



Impact of Timing in Design for Environment



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Positive Environmental Impact of Nanomanufacturing

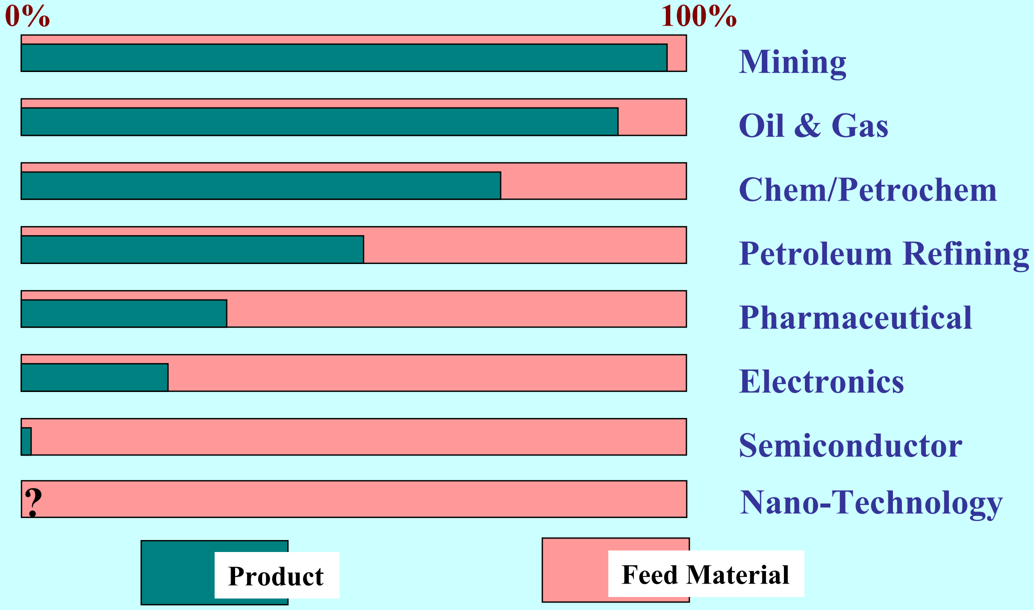
Evolutionary:

- **Opportunity to phase out problematic materials which are deeply rooted in present manufacturing (e.g. PFCs, PFOS).**

Revolutionary:

- **Opportunity to phase out problematic process paradigms and replace them with more ESH-friendly processing approaches (e.g. move from *subtractive* to *additive* processing).**

Material Usage Index in Various Industries



Engineering Research Center for Environmentally Benign Semiconductor Manufacturing

An Example of Subtractive Processing

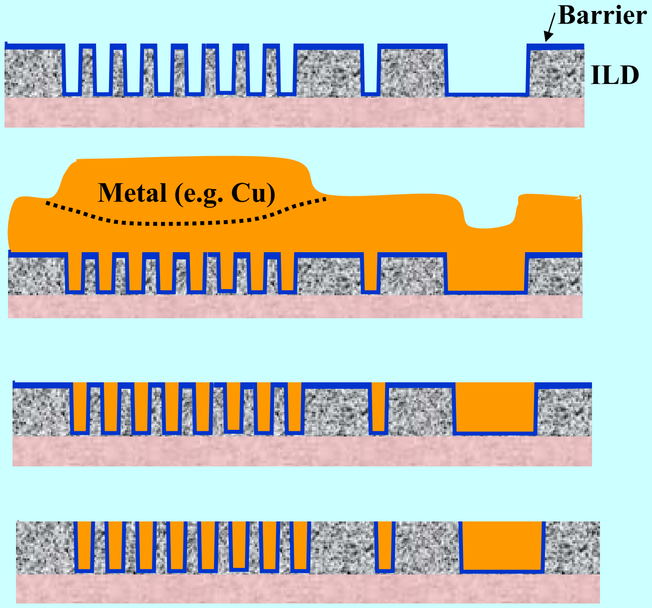
Conventional CMP of Interconnect Copper

Dielectric patterning
Barrier deposition

Copper deposition
(seed, fill)

CMP

Top barrier removal

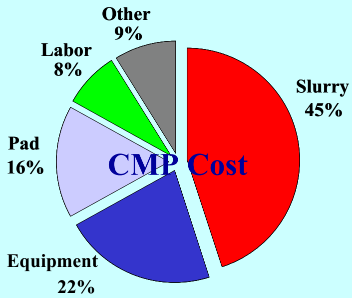


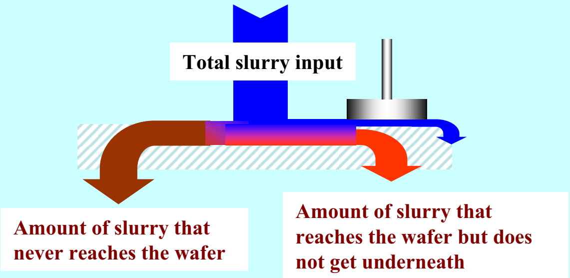
Engineering Research Center for Environmentally Benign Semiconductor Manufacturing

Chemical Mechanical Planarization (CMP)

Ara Philipossian (UA)

- One of the fast growing processing segments
- Major source of nano particle emission in S/C fabs
- Costly and wasteful operation: For a typical 200-mm factory:
  - 6,000,000 liters of slurry ($20M) per year
  - 300 metric tons of solid waste per year



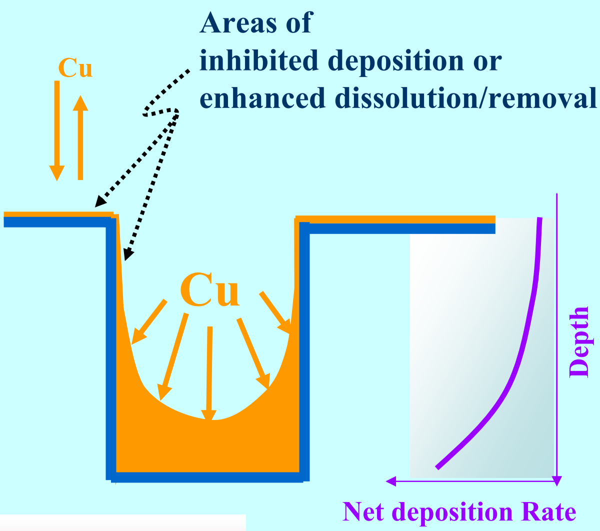


Amount of slurry that does the actual polishing is often <u>less than 10%</u>

Additive Metal Damascine Process

Selective Deposition:

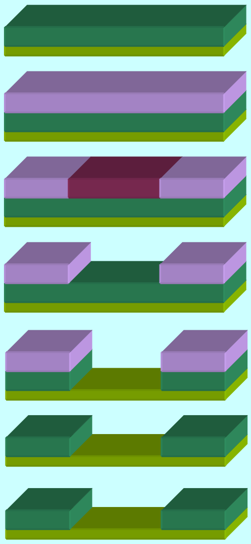
- Diffusion-limited inhibitors for local rate modification
- Cyclic deposition and dissolution
- Simultaneous deposition and planarization



Minimizes need for planarization

An Example of Subtractive Processing

Deposition and Patterning of Dielectrics



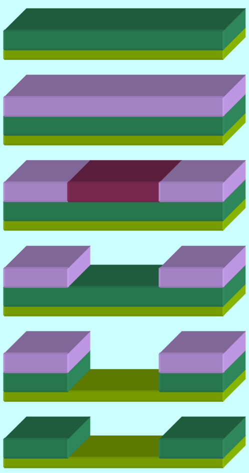
Conventional Lithography	*ESH Issues*
dielectric deposition	**Precursors, HAPs, wastes**
spin-on imaging layer	**VOCs, waste**
selective irradiation	**VOCs, radiation**
development in aqueous base	**VOCs, HAPs**
dielectric patterning	**HAPs, PFCs**
resist strip	**A/B chemicals, solvents**
imaging layer strip	**A/B chemicals, UPW**

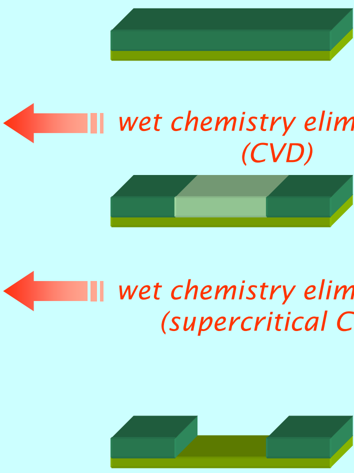
Additive Approach

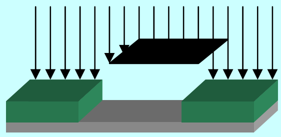
Deposition and Patterning of Dielectrics

Karen Gleason (MIT), Chris Ober (Cornell)

	Conventional Lithography	All-Dry, Resistless Lithography	Selective Dielectric Deposition
dielectric deposition			
spin-on imaging layer		*wet chemistry eliminated (CVD)*	
selective irradiation			
development in aqueous base		*wet chemistry eliminated (supercritical CO_2)*	
dielectric patterning			
imaging layer strip			*Photo initiated CVD*





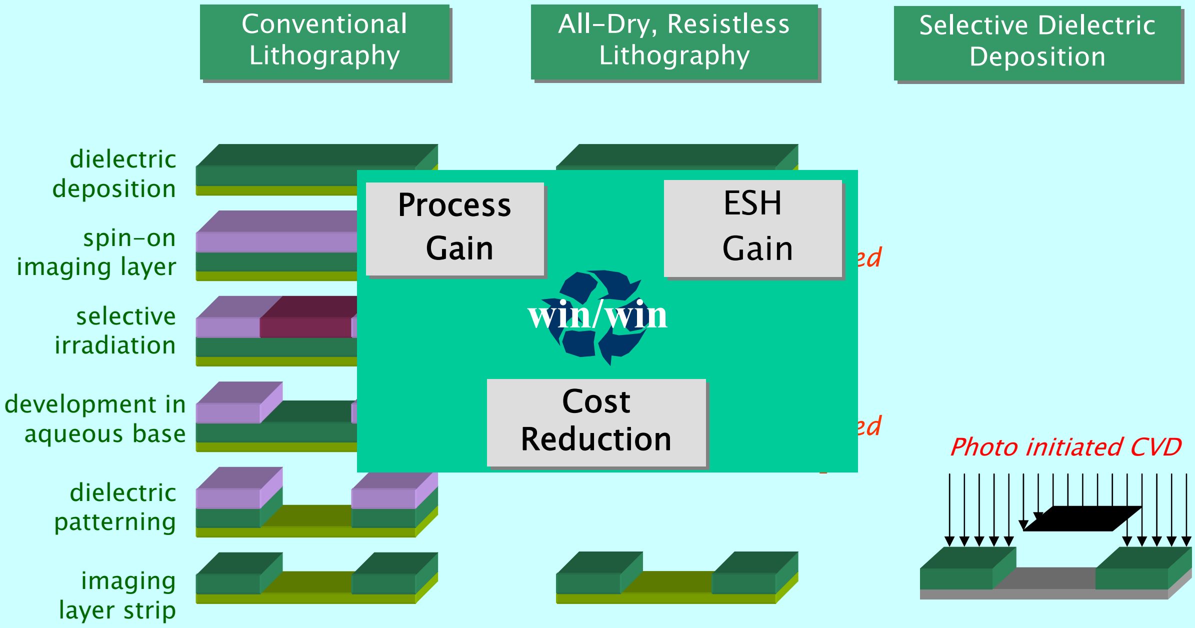


Engineering Research Center for Environmentally Benign Semiconductor Manufacturing

Additive Approach

Deposition and Patterning of Dielectrics

Karen Gleason (MIT), Chris Ober (Cornell)



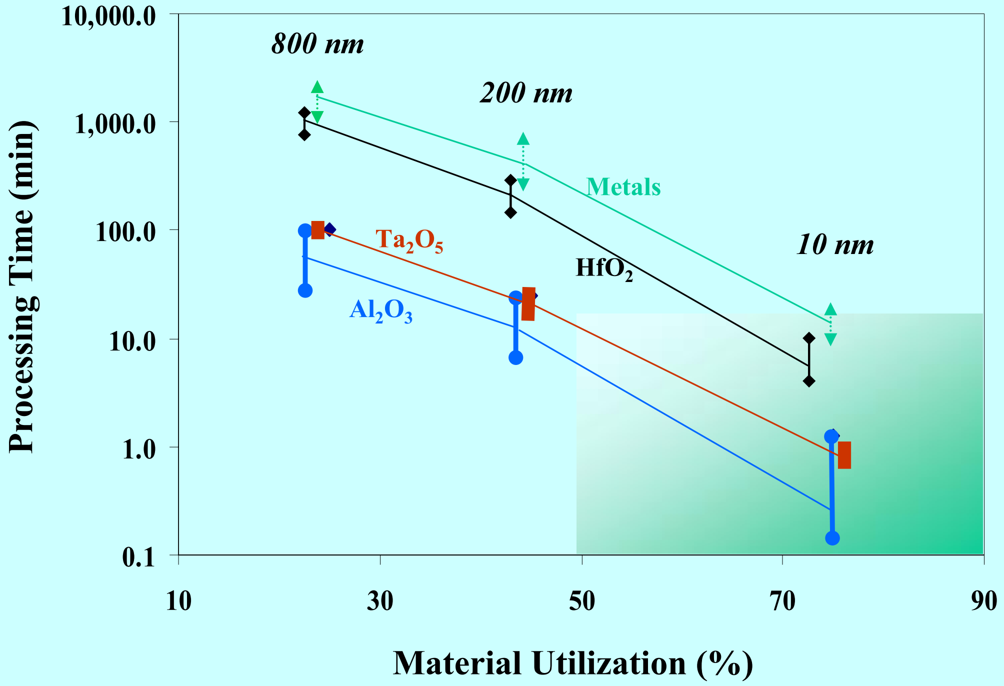
Best Examples of Additive Processing

Dan Herr and Victor Zhirnov (SRC)

	EUV Lithographic Subtractive Patterning 32 nm	Growth of a Baby [Bio-Assisted Self-Assembly]	Bio Advantage
Bits patterned per second	8.59E+09 bits/s/masking layer	7.53E+17 amino acid equivalents/s	8.77E+07
Energy required per bit	1.46E-12 J/bit/masking layer	1.29E-20 J/amino acid equivalent	1.13E+8

Evolution = Environmentally Friendly

Feasibility of Additive Processing in Nano-Scale



Outlook for Additive Processing

- **In addition to having many ESH advantages, additive processing is becoming more feasible in terms of cost, material/energy consumption, throughput, and defect management.**
- **As we move from micro to nano scale, the additive techniques might be the only processing route.**
- **Great opportunity for revisiting some of the existing additive technologies that have not made it into manufacturing, and for inventing some new ones.**
- **Perhaps the most important change in manufacturing paradigm as we move from micro to nano.**

Thank you

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www.erc.arizona.edu

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Contractor Self-Management in TSMC

- What About This Program
- Why This Program
- How This Program
- Current Status and Benefit

Taiwan Semiconductor Manufacturing Company
(TSMC)

ydtzeng@tsmc.com

Empowering Innovation

What About This Program

Jan.2005 | Jun.2005 | Dec.2005 | Jun.2006 | Dec.2006 | Jun.2007

5/26/'05
Project kick-off:
Top managers support

1st phase start
(8/1'05~5/31'06)

2nd phase start
(3/3'06~12/15'06)

6/1'06，skill training
certificate is needed
for High Risk workers

3rd phase start
(9/11'06~6/15'07)

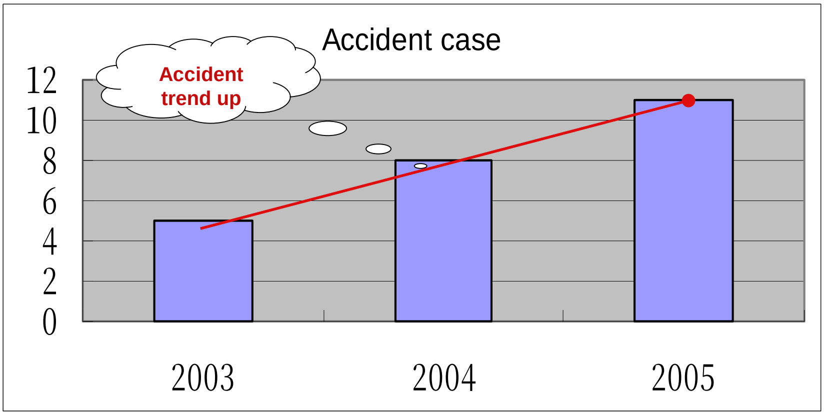
7/1'07 OHSAS18001
certificate is needed for
High Risk work contractor
companies

Target: 1. 2000 high risk workers pass the skill training by 5/31/2006
2. 90 contractor companies pass the OHSAS18001 certification by 6/31/2007

Empowering Innovation

Why This Program

❖TSMC contractor major accident trend



Major accident definition：Real Fire case、Serious injury

Why High-risk Worker Skill Training

❖ TSMC contractor accident analysis(Jan. 2004 ~ Dec. 2004)

Accident Description	Lack of skill			awareness
	worker	Contractor supervisor	tsmc supervisor	
Electric arc accident when plug-in switch unit installation	V	V	V	
Mis-operation ,when disconnect a pipeline	V	V	V	V
Fire alarm, hot work ignite spill containment absorbent	V	V	V	V
Gas leak, Miss operation when switching the gas cylinder	V			V
Gas leak, insufficient cycle purge when disconnect VCR	V	V	V	
Traffic accident, Run over by a wafer truck				V
Fire, in transformer room				V
Chemical spill caused people injury	V	V		

Analysis Result: Most of the workers/supervisors and tsmc supervisors lack of skill training and awareness.

Empowering Innovation

Why OHSAS18001 for High-risk Contractor

Current Measures for Contractor Management

Preparation → pre-construction → under-construction → post-construction

Preparation
- 6-hr orientation by employer
- 2-hr ESH training by TSMC
- ESH rule endorsement by employer

pre-construction
- Safety pre-meeting
- Jab Safety Analysis (JSA)
- Tool box meeting (risk announcement and PPE preparation)

under-construction
- Work safety inspection and Audit

post-construction
- Waste disposal
- Recovery

1.Contractors didn't provide sufficient skill training to workers
2.Contractors safety rely on TSMC's safety control ,didn't have self-management ability

How This Program

Skill Training

- Enhance ability of contractor workers and supervisors
- Put TSMC's contractor skill training requirements into OHSAS18001 as an external requirement

Contractor OHSAS-18001 Certification

- Establish Contractor self-management system
- Put TSMC's contractor management requirements into OHSAS18001 as an external requirement

High Risk Work Definition

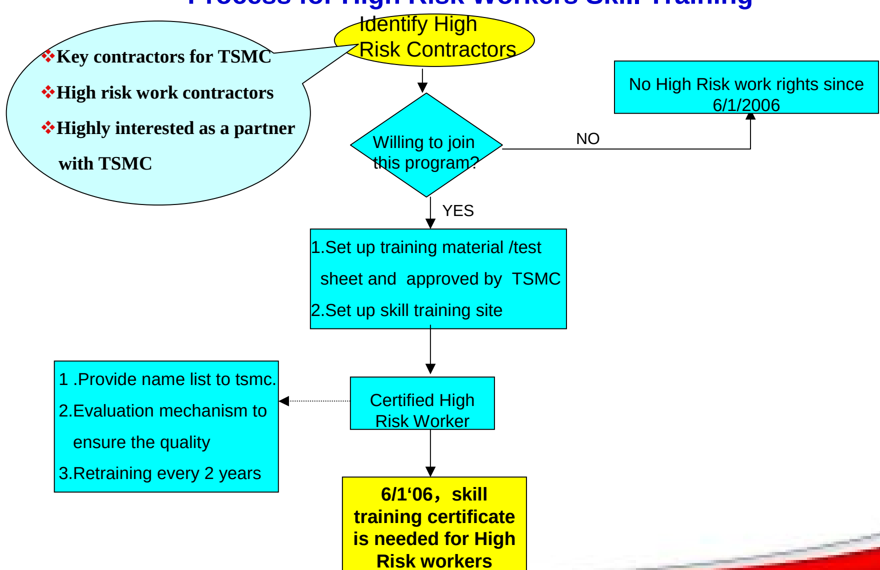
Facility high risk work : 18 items

1. Gas piping disconnect or cutting
2. Chemical piping disconnect or cutting
3. GAS piping disconnect or cutting
4. SEX(Special gas Exhaust), AEX(Ammonia), VEX (Volatile Organic) disconnect or cutting
5. Scrubber chemical supply piping disconnect
6. Hot work in solvent room or diesel oil storage room
7. Hot work in flammable or pyrophoric gas room
8. Hot work of flammable gas piping
9. Hot work of solvent piping
10. Hot work of diesel oil tank or piping
11. Hot work of VEX
12. Confined space work
13. VOCs abatement clean work
14. High voltage electric work
15. Electric switch plug-in work
16. O3 destructor replacement
17. Dangerous machine work (crane or hoist)
18. Inert gas suppression system (CO2, Halogen) modification, expansion or test

High risk work :
The works may cause fire, explosion, serious injury or death

How This Program

Process for High Risk Workers Skill Training



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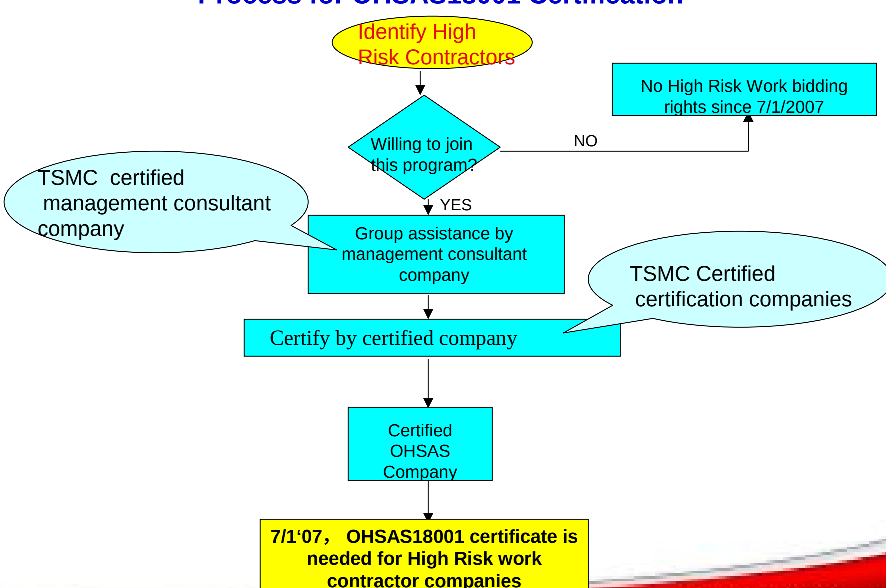
How This Program

❖High-risk Worker Skill Training

- Standard Operation Procedure (S.O.P.) preparation (Approved by TSMC)
- High risk training material preparation (Approved by TSMC)
- Set up skill training site (Approved by TSMC)
- Conduct skill training (Sampling audit by TSMC)

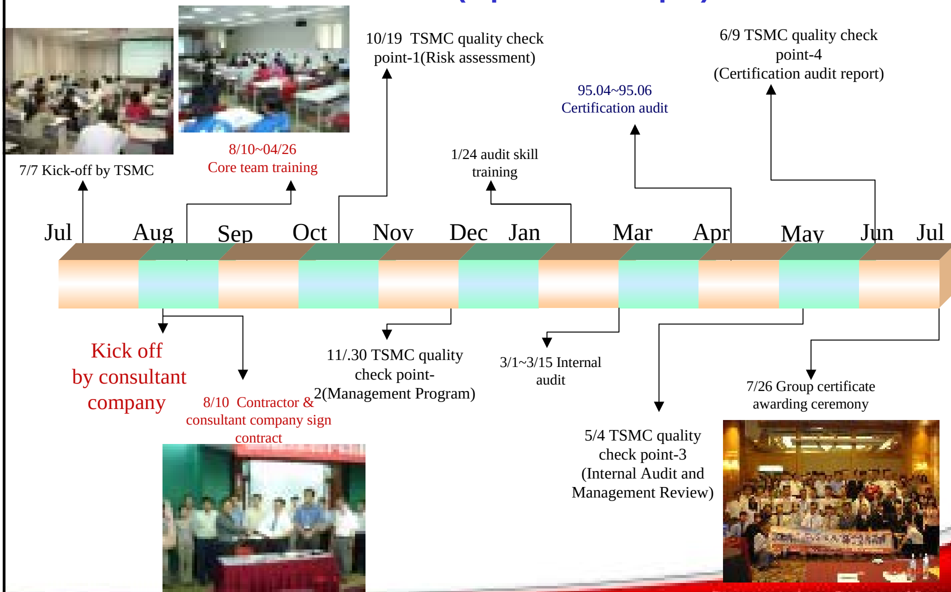
How This Program

Process for OHSAS18001 Certification



How This Program

❖ OHSAS18001 certification (1 phase example)



Current Status

- 2395 workers passed the high-risk skill training
- 89 high-risk contractors pass the OHSAS18001

Group certificate awarding ceremony(for 1 phase)

Empowering Innovation

Added Value for Certified Contractors

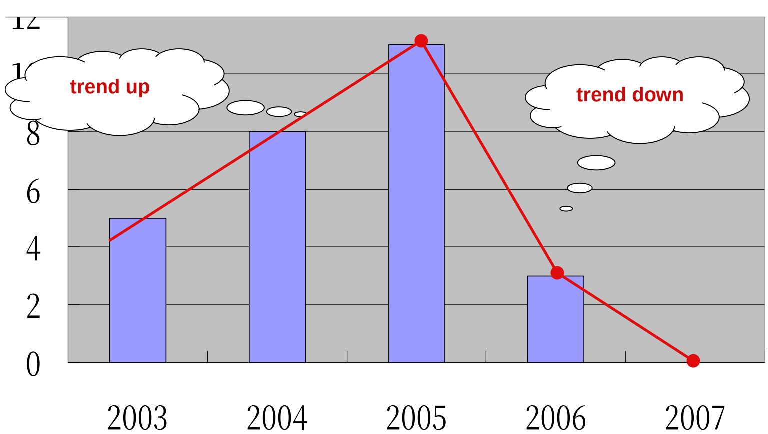
- Post information to the AASPI (Allied Association for Science Parks Industries) web site **(http://www.asip.org.tw)**

Overall description for this project

Certified Contractor list

Benefit

- **tsmc contractor major accident trend (Jan. 2002 ~ May. 2007)**



Major accident definition：Real Fire case、Serious injury

~Thank you very much~

Taiwan Semiconductor Manufacturing Company

Y.D.Tzeng
June 2007

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