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出國報告（出國類別：其他）

赴加拿大蒙特婁參加 SOFC XII 研討會公差報告

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派赴國家：加拿大
出國期間：100 年 4 月 29 日~100 年 5 月 8 日
報告日期：100 年 6 月 8 日

摘 要

每二年舉辦一次之國際固態氧化物燃料電池研討會，為國際上研發固態氧化物燃料電池(Solid Oxide Fuel Cells, SOFCs)相關領域中最重要的研討會之一，第十二屆國際固態氧化物燃料電池研討會(Twelfth International Symposium on Solid Oxide Fuel Cells (SOFC-XII))與美國電化學學會之 219th ECS Meeting 合併於 2011 年 5 月 1 日至 6 日在加拿大之蒙特婁市舉行，會議地點為 The Palais des Congrès de Montréal。本屆會議討論主題包括 1.SOFC 電池堆及系統；2.電解質材料製程及效能；3.陰極材料；4.電池設計、測試及效能；5.陽極材料；6.替代燃料；7.模擬；8.連接板及封裝材料；9.固態氧化物電解池等。SOFC-XII 研討會參與學者專家來自全球 32 國，人數超過 400 人，計發表 349 篇論文，其中包括口頭論文發表 184 篇，海報論文發表 165 篇。筆者以“Characteristics of the Sintered Phlogopite mica/SiO_2-B_2O_3-Al_2O_3-BaO-La_2O_3 Glass Blends”論文參加會議徵文獲接受，並於會議中以口頭論文方式發表。此外，李員現為本所固態氧化物燃料電池計畫之分項主持人，並獲歐盟燃料電池論壇(European Fuel Cell Forum, EFCF)邀請為國際顧問專家委員會 (International Board of Advisors of the EFCF)之成員，藉由 ECS 會議期間與國際之燃料電池專家，商討國際之最新及未來發展趨勢，強化本所與國際間之合作關係，並做為後續燃料電池研究計畫與國際接軌及後續工作推展之參考。

目　次

圖 目 次

一、目的

國際固態氧化物燃料電池研討會每二年舉辦一次，爲國際上研發固態氧化物燃料電池(Solid Oxide Fuel Cells, SOFCs)相關領域中最重要的研討會之一，第十二屆國際固態氧化物燃料電池研討會(Twelfth International Symposium on Solid Oxide Fuel Cells (SOFC-XII))與第 219 屆美國電化學學會會議(219^{th} ECS Meeting)，合併於 2011 年 5 月 1 日至 6 日在加拿大之蒙特婁市舉行。會議討論主題包括 1.SOFC 電池堆及系統；2.電解質材料製程及效能；3.陰極材料；4.電池設計、測試及效能；5.陽極材料；6.替代燃料；7.模擬；8.連接板及封裝材料；9.固態氧化物電解池等。此外，會中並有全球之 SOFC 相關廠商參展可資觀摩，亦有來自世界各地的 SOFC 學者專家齊聚一堂討論及交換研究心得。

鑑於所內執行之高溫燃料電池發電系統計畫，自 92 年投入 SOFC 之研發工作，其目標包括基本材料（如電池單元、封裝劑及連接板材料）研究、電池堆組裝技術開發，以及發電系統之模擬與測試等等，近年來已陸續獲得具體的研發成效，除了在國際會議上發表之外，並與歐美從事 SOFC 之研發機構維持良好之合作關係。此次筆者參加會議以“Characteristics of the Sintered Phlogopite mica/SiO_2-B_2O_3-Al_2O_3-BaO-La_2O_3 Glass Blends”爲題之論文投稿獲接受，並奉核可派赴參加會議得於會議中以口頭方式發表研發成果，綜觀參與本次會議之目的，除爲汲取國際的研發經驗，藉由問題的討論以強化與著名研究機構之人脈關係，並吸收相關領域新知以利與國際發展現況接軌之外，並希望藉由成果論文的發表，益發彰顯本所於此領域的研發成效，除利於相關計畫工作的加速推動，更可有效提昇本所於相關研發領域之國際可見度。

此外，李員現爲本所固態氧化物燃料電池計畫之分項主持人，並獲歐盟燃料電池論壇(European Fuel Cell Forum, EFCF)邀請爲國際顧問專家委員會 (International Board of Advisors of the EFCF)之成員，藉由 ECS 會議期間與國際之燃料電池專家，商討國際之最新及未來發展趨勢，強化本所與國際間之合作關係，並做爲後續燃料電池研究計畫與國際接軌及後續工作推展之參考。

二、過程

第 12 屆國際固態氧化物燃料電池研討會(Twelfth International Symposium on Solid Oxide Fuel Cells (SOFC-XII))與美國電化學學會(The Electrochemical Society)之 219^{th} ECS meeting，於 2011 年 5 月 1 日至 6 日在加拿大蒙特婁市之 The Palais des Congrès de Montréal 合併舉行。此次筆者係以"Characteristics of the Sintered Phlogopite mica/SiO_2-B_2O_3-Al_2O_3-BaO-La_2O_3 Glass Blends"爲題論文參加會議徵文，投稿及申請參加會議之相關時程分述如后：

2010/11/15 論文加長型摘要投稿。

2010/12/21 論文投稿摘要獲接受，發表方式爲海報(Poster)發表。

2011/01/07 論文全文投稿。

2011/01/10 論文發表方式獲通知更改爲口頭(Oral)發表。

2011/01/13 論文全文獲接受。

2011/03/04 所內出國公差申請簽核。

2011/03/11 所內出國公差申請核准。

2011/03/22 參加會議註冊。

2011/05/06 論文口頭發表。

上述投稿論文接受函如附錄一，論文口頭發表時間爲 20 分鐘，，論文全文亦收錄於 ECS Transactions Vol. 35, Issue 1 中，論文全文如附錄二。

（一）行程說明

筆者本次出國公差期間自 100 年 4 月 29 日至 5 月 8 日，共計 10 日，赴加拿大蒙特婁市參加 Twelfth International Symposium on Solid Oxide Fuel Cells (SOFC-XII)。相關行程略述如后：

04/29(五) 搭乘 23:55 之長榮航空 BR10 由桃園首途直飛溫哥華，於 04/29 (五)19:15(當地時間)抵達，轉加拿大航空國內線至蒙特婁。

04/29(五) 搭乘 23:35 之加航 AC182 由溫哥華至蒙特婁，於 04/30(六)07:10 抵達蒙特婁 Pierre Elliott Trudeau 國際機場(圖 1)(註：蒙特婁與台北時差–12 小時)，乘機場-市區巴士前往旅館。

04/30(六) Le Westin Montreal 旅館(註：大會選定住宿旅館)check-in 及熟悉環境。

圖 1　蒙特婁 Pierre Elliott Trudeau 國際機場一瞥。

圖 2　SOFC-XII 研討會會場－The Palais des Congrès de Montréal 一隅。

05/01(日) SOFC-XII 會議第一天，前往會議地點−The Palais des Congrès de Montréal(圖 2)報到、領取資料(圖 3)。

05/02(一) SOFC-XII 會議第二天，08:00~12:00 & 14:00~16:20 (Plenary and Oral

圖 3　SOFC-XII 研討會會場－報到註冊處。

presentation session)，18:00~20:30 (Poster session)。

05/03(二) SOFC-XII 會議第三天，08:00~12:00 & 14:00~17:40 (Oral presentation session)，18:00~20:30 (Poster session)。

05/04(三) SOFC-XII 會議第四天，08:00~12:00 & 14:00~17:20 (Oral presentation session)，18:00~參加 SOFC-XII 之 Banquet (於 Le Westin Montreal 之宴會廳)。

05/05(四) SOFC-XII 會議第五天，08:00~12:00 & 14:00~17:40 (Oral presentation session)，18:00~20:30 (Poster session)。

05/06(五) SOFC-XII 會議第六天，08:00~12:00 & 14:00~17:00 (Oral presentation session & Concluding remarks)，11:20~11:40 口頭報告。筆者於早上 07:50 check-out 前往會場，約 16:00 離開會場。

05/06(五) 搭乘市區-機場巴士前往機場。搭乘 19:55 之加航 AC129 由蒙特婁飛至溫哥華，並於 05/06(五)22:15 抵達等候轉機。

05/07(六) 搭乘 02:20 之長榮航空 BR9 由溫哥華直飛桃園，並於 05/08(日)05:30(台北時間)安返抵達。

（二）SOFC-XII 議程

本屆 SOFC-XII 會議之主要贊助者爲美國電化學學會(The Electrochemical Society, Inc.)，其次爲日本 SOFC 學會(The SOFC Society of Japan)，其餘贊助者包括 High Temperature Materials, Battery and Energy Technology Divisions of The Electrochemical Society、Dokiya Memorial Fund at The Electrochemical Society 等研究機構。

本屆會議主席爲由美國太平洋西北國家實驗室(Pacific Northwest National Laboratory, PNNL)之 Dr. Subhash C. Singhal 以及日本京都大學(kyoto University)之 Prof. Koichi Eguchi 擔任，此外各分組議程則另設協同主席。爲期 6 天的會議中，除了口頭及海報論文發表之外，亦包括 34 家廠商的參展。5 月 2 日上午 08:00~12:00 正式進行大會議程，由國際上知名之 SOFC 研究機構或公司簡報渠等最新之技術進展；同日下午 14:00~16:20 則分別於 2 大會議廳(圖 4)同時進行首日之 SOFC Stacks & Systems I 及 SOFC Electrolyte Materials, Processing and Performance 等分組口頭報告議程，5 月 3 日 08:00~17:40 分別進行 SOFC Stacks & Systems II、Cell Design, Testing and Performance I 及 SOFC Cathode Materials II 之

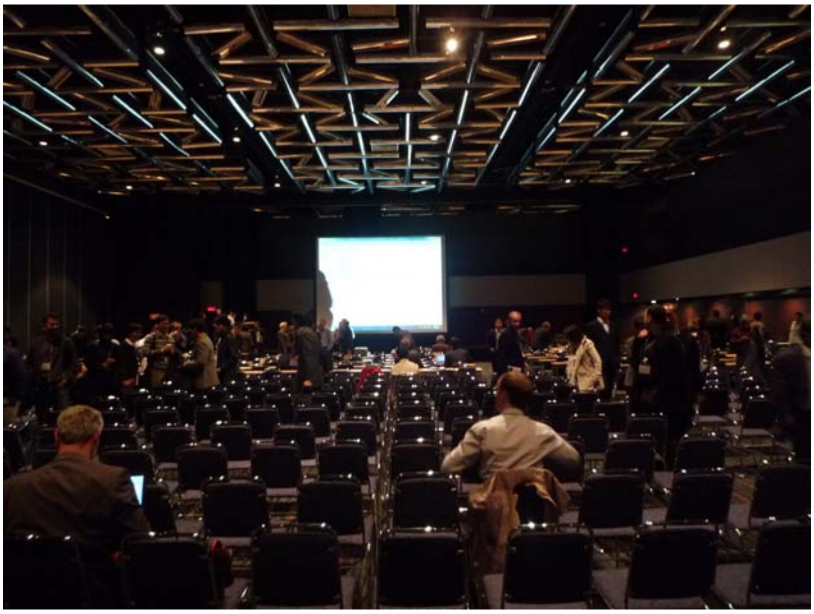

圖 4　口頭論文發表之會議廳 I(攝於中場休息)。

圖 5　參加 SOFC-XII 之人數踴躍(攝於中場休息)。

分組口頭報告；5 月 4 日 08:00~17:20 分別進行 Cell Design, Testing and Performance II, III、SOFC Cathode Materials III 及 SOFC Anode Materials I 之分組口頭報告，是日晚間並舉行晚宴；5 月 5 日 08:00~17:40 分別進行 SOFC Alternate Fuels I, II 及 SOFC Anode Materials II, III 之分組口頭報告；5 月 6 日 08:00~17:00 分別進行 SOFC Modelling I, II、SOFC Interconnect and Seal Materials、Solid Oxide Electrolysis 等分組口頭報告及閉幕致詞。上述每位口頭論文發表者之報告時間均為 20 分鐘；分組海報論文發表則於 5 月 2、3 日及 5 月 5 日之每日下午 18:00~20:30 進行，總計本屆 SOFC 研討會參與人數約 400 人，口頭論文發表 184 篇，海報論文發表 165 篇；詳細之研討會議程見附錄三，參加會議人數踴躍如圖 5。

（三）與會過程

本次核研所前往參加會議計 2 員，又大會之口頭論文發表分兩會議廳同時進行，因此聆聽論文發表採分工合作方式進行。

05/01 至會場(The Palais des congrès de Montréal)辦理報到、領取會議資料，本次註冊 SOFC-XII 會議，除發與 219^{th} ECS Meeting 論文摘要集及 ECS

Transactions 35(1)論文全文光碟及隨身硬碟之外，已無供給紙本之論文集，估計對於節能減碳實有相當助益。(註：上述論文全文光碟均已送交核研所圖書館收藏以供借閱)

05/02 上午參與 SOFC Plenary Session 之分組議程，主持人爲 Dr. Subhash Singhal 及 Prof. Koichi Eguchi，主要爲聽取主席致詞及由國際上知名之 SOFC 研究機構或公司簡報渠等技術之最新進展。下午分別參與口頭論文報告議程 1.SOFC Stacks & Systems I，主持人爲 Robert Steinberger-Wilckens 及 Shailesh Vora；2.SOFC Electrolyte Materials, Processing and Performance，主持人爲 Eric Wachsman 及 Harumi Yokokawa(圖 6)。晚間則瀏覽 SOFC Poster I (Cathode, Interconnection and Seals)分組海報論文(圖 7, 8)，主持人爲 Fanglin Chen 及 Nguyen Minh。(註：Dr. Nguyen Q. Minh 因身體微恙，並未出席主持，筆者亦曾前往探視)

05/03 上午分別參與口頭論文報告議程 1.SOFC Stacks & Systems II，主持人爲 Karl Foger 及 Mark Williams，議題延續首日之 SOFC Stacks & Systems I；2.SOFC Cathode Materials I，主持人爲 Nigel Brandon 及 Tatsuya Kawada。下午分別

圖 6　口頭論文發表之會議廳 II(攝於中場休息)。

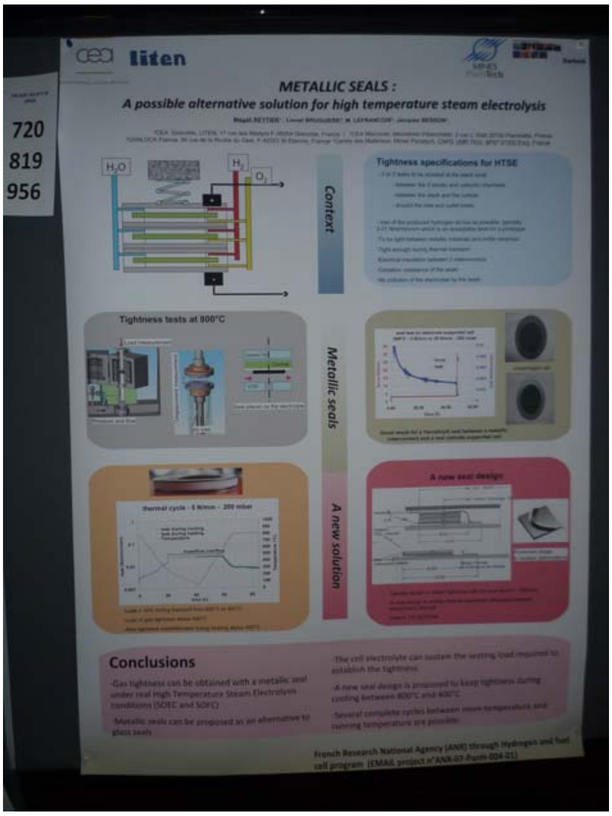

圖 7　海報論文發表例一。

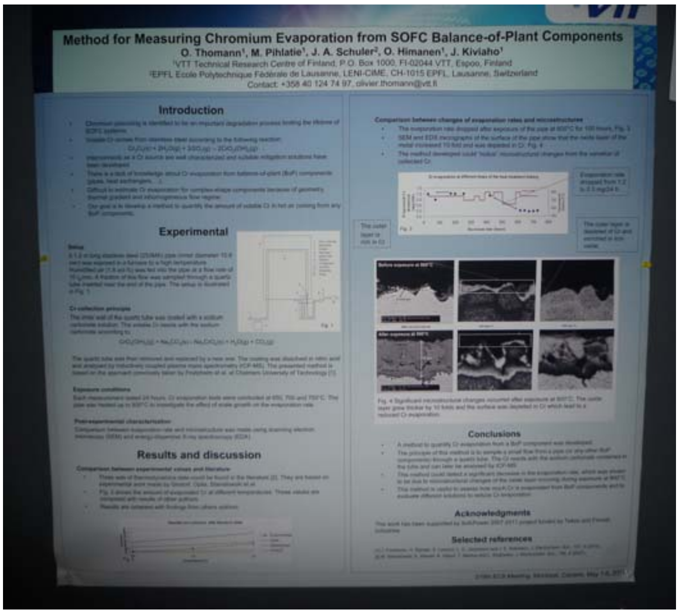

圖 8　海報論文發表例二。

參與 1.SOFC Cell Design, Testing & Performance I；2.SOFC Cathode Materials II 之分組論文報告議程，主持人分別爲 Viola Birss、Teruhisa Horita 及 Tatsumi Ishihara、Kevin Kendall。晚間則瀏覽 SOFC Poster II (Electrolyte and Anode) 分組海報論文，主持人爲 Srikanth Gopalan 及 Lincoln Miara。

05/04 上午分別參與 1.SOFC Cell Design, Testing & Performance II；2.SOFC Cathode Materials III 之分組議程，主持人分別爲 John Irvine、Anil Virkar 及 Brian Borglum、Kazunari Sasaki。下午分別參與 1.SOFC Cell Design, Testing & Performance III；2.SOFC Anode Materials I 之分組論文報告議程，主持人分別爲 Alan Atkinson、Anthony Petric 及 Scott Barnett、Ming-Fang Han。晚間則參加大會安排之晚宴(圖 9)。

05/05 上午分別參與 1.SOFC Alternate Fuels I；2.SOFC Anode Materials II 之分組議程，主持人分別爲 Joongmyeon Bae、Steven Mclntosh 及 Anke Hagen、Junichiro Mizusaki。下午則分別參與 1.SOFC Alternate Fuels II；2. SOFC Anode Materials III 之分組議程，主持人分別爲 Mogens Mogensen、Turgut Gur 及 Josephine Hill、Ellen Ivers-Tiffee。晚間則瀏覽 SOFC Poster III (Cell and Stack

圖 9　SOFC-XII 大會晚宴一景。

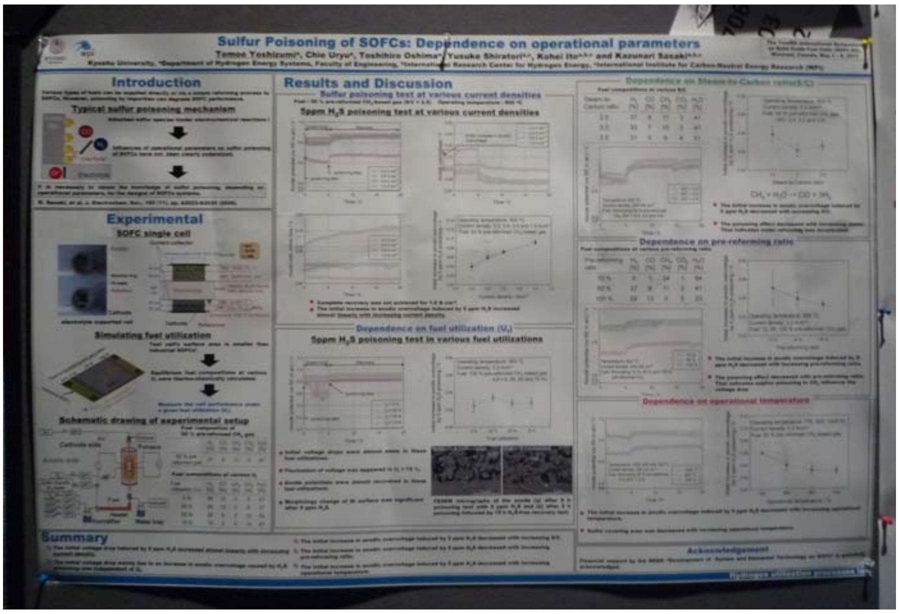

圖 10　海報論文發表例三。

Design, Performance and Modelling)分組海報論文(圖 10)，主持人爲 Yanhai Du 及 Subhash Singhal。

圖 11　Nextech 展示 500 W(10 cells)電池堆。

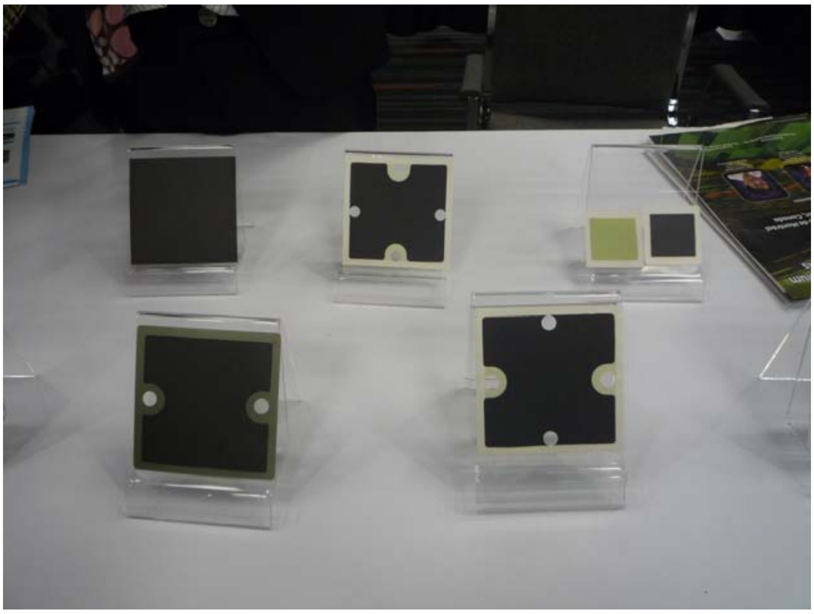

圖 12　NIMTE 展示 ESC type 電池片。

05/06 上午分別參與 1.SOFC Modelling I，主持人爲 Wilson Chiu、Robert Kee；2.SOFC Interconnection and Seal Materials，主持人爲 Jeff Fergus、Jari Kiviaho 之分組議程，後者之議題與筆者研究領域最爲相關，11:20~11:40 則由筆者進行口頭論文報告(簡報內容見附錄四)。下午則分別參與 1.SOFC Modelling II；2.Solid Oxide Electrolysis 之部分議程，主持人分別爲 Wolfgang Bessler、Koichi Eguchi 及 Niels Christiansen、Subhash Singhal。然因行程班機因素，筆者等約於 16:00 離開會場。

此外，本屆會議計有 34 家廠商參展(參展廠商名錄見附錄五)，其中直接與 SOFC 產業或技術相關之參展廠商或研究機構包括 Fuel Cell Technologies, Fuelcellmaterials, FuelCon AG, Kerafol GmbH, Forschungszentrum Julich GmbH, NexTech Materials, NIMTE 等等，部分參展內容略錄如圖 11, 12。

（四）人員接觸

筆者本次參加會議期間與國內與會人士接觸部分，包括國立中央大學機械系林志光教授及其博士生。於大陸與會人士部分，則與中國北京礦業大學燃料電池

聯合研究中心副主任韓敏芳教授談論及雲母混摻玻璃封裝材料特性問題，韓教授並建議核研所 SOFC 研發團隊可參與 2012 年 10 月 9-12 日於中國大陸昆山所舉行之亞洲 SOFC 研討會(The 2012 Asian SOFC Symposium)。此次與會之國際學者專家之中,許多人士曾經來台參與過核研所舉辦之 SOFC 研討會,例如 Dr. Nguyen Q. Minh，筆者向其請益 RSOFC 問題；此外，亦與 Hitachi Metals, Ltd.之 Mr. N. Yasuda 就 ZMG232 系列連接板交換意見。

三、心得

（一） 今年 3 月 11 日日本大地震、海嘯所衍生的福島核安事件，對於國際正在復甦的核能產業造成顯著的衝擊；一般咸認，在福島事件後，將歷經一段爲期超過十年以上的經驗回饋期，後續將就核能電廠的運轉及核安事故的應變措施做省思及檢討，以強化、提昇核電廠之運轉維護品質及核能安全。而就能源的需求端及供應端而言，節能及潔淨等新高效能源技術的開發，將是全球未來的開發重點項目。

（二） 本次參加 SOFC-XII 會議人數超過 400 人，人數或發表論文篇數(349 篇)，雖不及上屆(SOFC-XI)之 450 人及 363 篇爲多，但仍爲本次 ECS 會議參與人數及論文篇數最多最多的分組。推測人數或發表論文篇數略低於上屆的可能原因有二，其一爲受日本福島事件影響，其二爲目前國際許多燃料電池相關會議興起，參與人數及論文篇數略有稀釋。

（三） 會議主席 Dr. Subhash C. Singhal 於大會開幕致詞時提及，目前雖然在美國已裝設超過 120 組大於 100 kW 之 SOFC 發電系統。同時，住家型之 SOFC CHP 系統不論在裝設及實地測試方面，均有顯著的進展。然而，不利於 SOFC 之 Market Drivers 仍在於 Cost, Lifetime, Performance 等。綜觀本屆研討會之廠商參展部分，均未見有 SOFC 系統之實體展出，而如電極材料研發的報告仍佔相當大比例，足見 SOFC 仍處於研發階段，抑或是仍處於產業化的瓶頸期。

（四） 在能源的供需議題上，其需求端需藉由開發節能減碳及提高效率的技術以降低能源的需求量；在供應端方面，則必須考慮不同能源型態所可提供的規模及尺度。以國內的情況，由於地理環境的限制，本身並無太多的能源資源，風能及太陽能所能提供的能源規模及尺度偏低，再生或新能源所占的比例也偏低。依據經濟部 2010 年的能源統計資料顯示，再生能源僅占總能源供給的 0.43%，再生能源發電量占總電力供給的 4.82%，其中慣常水力發電即占了超過一半以上的比例。從某個層面而言，在「非水力」的再生能源發展上仍有很大的待開發空間；就實務面而言，再生或新能源所能提供的能源額度相當有限，此一情況在短期內已難有顯著的突破。若後續國內核能所可提供的電力無法提昇或逐步遞減，則在經濟穩健成長情況下，電力需求仍有增加的趨勢，其二者一來一

去間所需的能源差額，將需仰賴化石燃料填補。因此如何提高化石燃料的效率，達到節能減碳的效果，將是未來必須面對的課題。而化石燃料所釋出的二氧化碳，是否可以有效捕捉、封存及再利用，亦將是能否達到政府所擬定的碳減排目標的關鍵。

（五） 固態氧化物燃料電池發電系統，其燃料源具多元化，碳氫化合物亦爲其中的選項之一，復以其具高能源轉換效率，可減少碳排放量及降低碳足跡，其尾端排放的主要氣體爲高濃度的二氧化碳，有利於後續的捕捉及封存作業。預期在未來的能源市場上，固態氧化物燃料電池發電系統需求量將持續增長，並可爲台灣的產業做出貢獻。

（六） 綜觀燃料電池的發展，其在高度期待及失望中更迭成長；惟以目前 SOFC 技術的發展狀況而言，其技術重點已從單純的學術研究，拓展置產業發展，目前 SOFC 發電系統的開發，已成爲國際 SOFC 研討會的重點項目，各國均投入顯著的研發資源進行系統開發及驗證工作。例如：日本已於 2007~2010 設置 233 組 SOFC 發電系統進行實證驗證測試，預期 2014 年左右完成相關的技術及法規規範，屆時 SOFC 產業將快速增長；目前已知，日本吉坤日礦日石能源公司將在 2011 年 10 月推出固體氧化物型燃料電池產品。

（七） 目前中國大陸已成爲全世界最大的二氧化碳排放國，其以煤炭做爲火力發電廠的主要燃料源，煤炭占其初級能量來源的 70%左右；爲求改善因之前追求經濟高成長後所衍生的後遺症之一，目前採取放緩經濟成長的策略，著重於環境及節能減排技術的開發。在大陸的「863 計畫」及「973 計畫」中，已將「二氧化碳減排、儲存和資源化利用」及 SOFC 發電系統開發，置入於重點開發項目之中；以中國大陸所擁有豐富的煤炭資源及稀土元素的蘊藏量，預期結合技術開發及產業量能，其未來之榮景可期。

（八） 美國歐巴馬政府在今年 2 月提出的 2012 年的能源開發項目及經費中，將 SECA 的經費預算一舉從 2010 年的 48.7 百萬美元刪減爲 0，其認爲 SECA 核心技術研發工作將告一段落，2012 年將不會有新的項目提出；另一方面，其大舉提高太陽能、生質能、地熱、建築及工業之能源效率提昇等的經費額度。惟其所擬定的 EERE(Energy Efficiency and Renewable Energy)分配額，在美國國會審議階

段，將其總經費需求從 DOE 編列的 3,200 百萬美元刪減 59.23%，為 1,305 百萬美元，其中並將 SECA 的經費修改為 25 百萬美元，雖低於目前的水平，一般咸認，美國燃料電池及氫能協會(Fuel Cell and Hydrogen Energy Assoication)在此一議題上做了相當的努力，並有顯著的成效。

（九） 美國 SECA 聯盟由 NETL(National Energy Technology Laboratory) 及 PNNL (Pacific Northwest National Laboratory)負責主導；其中 NETL.又負責技術產品的應用，及工業界、學界及專家間的協調、聯繫。目前 NETL 負責 SECA 計畫的經理人為 Dr. Shailesh D. Vora，其為美國佛羅里達大學材料科學暨工程博士，並於 1997 年取得匹茲堡大學的 MBA。之前其為西門子公司燃料電池部門的經理，在 2010 年 7 月進入 DOE，並於當年 12 月擔認目前的職務。PNNL 國家實驗室的 Dr. Subhash C. Singhal 原服務於西屋公司，為固態氧化物燃料電池的泰斗之一。在美國政府部門的運作上，會將產業的菁英納入政府的決策部門，縮短產官學界之間認知上的落差，此一彈性做法值得國內參考。

（十） 本所參與本次 SOFC-XII 之人員包括計畫主持人李瑞益博士及副工程師劉建國博士，分別就電池堆、系統及材料部分參加聽講，且計畫主持人對 SOFC 熟稔及見解層面深廣，與國際 SOFC 相關領域之多位專家學者或業界重要負責人充分討論交換意見，分工合作的效果，除了達到論文發表的目的，亦充分藉由問題的討論以強化與著名研究機構之人脈關係，並獲得相關領域的一手研發資訊，筆者認為實為一非常好的參加國際會議模式。

（十一）筆者認為聽講材料部分的人數相當多，其原因除了學術單位仍投入相當多的研究之外，或亦顯示材料部分的研究仍居瓶頸的發展時期；電解質材料的部分，相當多研究探討 CeO_2 相關材料，包括 GDC 和 Pr-CeO_2；陰極材料的部分則以 LSC, LSCF，以及 LNF 的研究為多；陽極材料則除了 Ni-YSZ 的相關研究之外，亦有多篇探討新陽極材料之開發，如 Au-Mo-Ni/GDC, Gd doped LSCM, Ba doped LSCM，重點在於 Redox stable 以及抗積碳及抗 S 毒化等。參展廠商部分如中國大陸之中國科學院寧波材料技術與工程研究所(NIMTE)展出 ESC type 之電池片，觀其外觀亦有與 Bloom Energy 所使用之相同設計。

（十二）連接板材料則偏重於低 Cr 之材料選擇以及保護層鍍膜之研究，如 MoCo 氧化

物，以及鍍膜特性等。一般常用之高含鉻不銹鋼用於 SOFC 做爲連接板，則其基本共識爲必須鍍膜，以防止鉻揮發造成毒化。另外如 Nextech 展示 10-cell stack (500 W)，其連接板使用 Aerosol spray deposition 方法於 ss441 不銹鋼披覆(Mn,Co)尖晶石作爲保護層，鍍膜厚度 5 μm 即可達良好的鉻阻絕效果，並且已有開發完成之鍍膜機台。氣膠沈積法(Aerosol Deposition Method, ADM)之優點爲製程簡單且可於低溫操作，除改善網印製程需後熱處理及免除濺鍍製程高成本之缺點，並可得相當緻密之陶瓷薄膜。此 ADM 之鍍覆薄膜方法對於計畫目前尋求低成本及高效能需求之 SOFC 保護層鍍膜製程，頗有値得參考之處。

（十三）本次 SOFC-XII 會議論文發表與 SOFC 高溫密封材料直接相關者僅 3 篇，相較上一屆仍少一篇，除筆者發表之“Characteristics of the Sintered Phlogopite mica/ SiO_2-B_2O_3-Al_2O_3-BaO-La_2O_3 Glass Blends”，另 2 篇分別爲“Metallic Seals: A Possible Alternative Solution for High Temperature Steam Electrolysis”及“Chemical Interaction of AO-SiO_2-B_2O_3-La_2O_3 (A=Mg, Ca, Sr, Ba) Glass Sealants with High Temperature and Low Temperature Electrolytes for SOFC”，均爲海報發表論文。其原因或許爲 SOFC 高溫密封用材料，無論在特性研究或技術目前已臻成熟，或是所開發的材料已可滿足現階段應用的要求，而相較於其他元件的開發，重要性已然降低。

（十四）相當多的華裔(大陸)學者參加本屆會議，或可顯示大陸投入 SOFC 之研究相當積極；國內參加本屆 SOFC 研討會之論文計有 4 篇，僅佔總發表論文數之 1.15%。其中口頭報告 2 篇，分別爲 1.核研所高溫燃料電池發電計畫之“Characteristics of the Sintered Phlogopite mica/SiO_2-B_2O_3-Al_2O_3-BaO-La_2O_3 Glass Blends”及 2.國立中央大學機械系林志光教授團隊之“Analysis of Joint Strength between a Metallic Interconnect and Glass-Ceramic Sealant for Use in Solid Oxide Fuel Cells”；另有海報論文 2 篇分別爲 1.國立中央大學機械系林志光教授團隊之“High-Temperature Stress-Rupture Properties of a Ferritic Steel for Solid Oxide Fuel Cell Interconnect”及 2.國立台灣大學化學系鄭淑芬教授團隊之“Pr Doped Ceria and $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_3$ Composite Cathode for Solid Oxide Fuel Cell”。上述 4 篇論文與核研所相關者佔 2 篇，顯示國內於 SOFC 領域之研發層

面仍有相當大的拓展空間。爲因應 SOFC 於國內產業化之推廣，相關研發能量除了縱向的深入之外，亦應考慮橫向之拓廣，藉由產、官、學、研等由點而線，由線而面的研發分工，再進一步垂直整合，方可奠立國內 SOFC 產業研發既深且廣的基礎。

四、建議事項

（一）核研所屬研發單位，定位爲國家實驗室，參與國際學術會議可有效汲取新知及發表成果，並提升國際能見度，建議爭取增加年度參與國際學術會議名額。

（二）每二年舉辦一次之國際固態氧化物燃料電池研討會(International Symposium on Solid Oxide Fuel Cells)，爲國際上研發固態氧化物燃料電池領域中最重要的研討會之一，下屆會議將於 2013 年 10 月 6-11 日於日本沖繩縣舉行，建議本所賡續選派優秀論文參加該會議發表，彰顯本所研發成果。

（三）相較於中國大陸學者專家參加本屆研討會之踴躍，國內前往與會之人數明顯偏低，除了國內學界對於固態氧化物燃料電池的研究缺乏整合之外，更缺少產業界於應用面的支持。本所研發固態氧化物燃料電池計畫著有績效，然似乎推廣不足，建議本所加強結合國內學、研等各界投入固態氧化物燃料電池研究能量，以研發所獲得之技術爲基礎，建構與產業連結之橋樑。

五、附錄

附錄一：論文接受函

附錄二：論文全文

附錄三：SOFC-XII 研討會議程

附錄四：口頭發表論文簡報檔

附錄五：參展廠商名錄

附錄一

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February 18, 2011

Dr. Chien-Kuo Liu
Institute of Nuclear Energy Research
1000, Wunhua Rd., Jiaan Village, Longtan Township
Taoyuan County, 32546
Taiwan

Dear Dr. Chien-Kuo Liu:

We are pleased to inform you that the following submission has been accepted for presentation at the 219th ECS Meeting in Montreal, Canada (May 1 - 6, 2011):

Abstract Number/Title: # 722: "Characteristics of the Sintered Phlogopite Mica_SiO_2-B_2O_3-Al_2O_3-BaO-La_2O_3 Glasses Blends" by C. Liu, K. Lin, and R. Lee
Presentation Type: Oral
Date/Time/Location: Friday, May 6, 2011 at 11:20h in Room 516C, Level 5
Symposium: B7 - Solid Oxide Fuel Cells XII (SOFC-XII)

The entire technical program for the Meeting, including the abstracts, is currently available on the ECS website (http://www.electrochem.org). Please keep the following guidelines in mind as you make your arrangements.

MEETING REGISTRATION: All authors attending the Meeting, including invited speakers, must pay the registration fee in order to present their paper. Online registration will open in early January and you may register here at that time: http://www.electrochem.org/meetings/biannual/219/219.htm The Early-Bird registration deadline is April 1, 2011.

HOTEL RESERVATIONS: The meeting will be held at The Montreal Convention Center (Palais des Congrès de Montréal), and special rates have been reserved at hotels closest to the Convention Center. Online reservations will open in early January and you may reserve your room here at that time: http://www.electrochem.org/meetings/biannual/219/219.htm The hotel reservation deadline is April 1, 2011. **We encourage you to make your reservations as soon as possible since we expect the hotels to fill up quickly.**

REVISED POSTER INFORMATION: Poster presentations must be displayed in English, **on a board approximately 3 feet 10 inches high by 3 feet 10 inches wide (1.17 meters high by 1.17 meters wide),** and correspond to the abstract number and day of presentation as detailed in the final program. PLEASE NOTE THAT THE NEW POSTER SIZE IS APPROXIMATELY HALF THE SIZE USED IN PREVIOUS ECS MEETINGS. Posters may be mounted starting at 13:00h on Monday for the Student Poster Session, which begins at 18:00h (judging begins at 15:00h) and 13:00h on Tuesday for the ECS General Poster Sessions, which begin at 18:00h.

REVISED ORAL PRESENTATION INFORMATION: Oral presentations must be in English. LCD projectors **and laptop computers will be provided as standard equipment for oral presentations.** PLEASE NOTE THAT YOU NO LONGER NEED TO BRING YOUR OWN LAPTOP TO ECS MEETINGS: YOU MAY BRING YOUR PRESENTATION ON A USB FLASHDRIVE INSTEAD. Speakers requiring special equipment must email their request to meetings@electrochem.org, by May 15, 2011 and appropriate arrangements will be made at the expense of the author.

VISA INFORMATION: This letter, mailed to all presenting authors with non-Canadian or non-U.S. addresses only, is frequently used by foreign travelers to obtain a Visa. If you have any questions, please contact Paul Urso, Associate Director of Technical Programming, at paul.urso@electrochem.org, or 1-609-737-1902 (extension 107), for assistance.

Your paper represents an important contribution to the success of the 219th ECS Meeting and we appreciate your participation.

Sincerely,

Paul J. Urso, Jr.
Associate Director of Technical Programming

附錄二

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Characteristics of the Sintered Phlogopite Mica/SiO_2–B_2O_3–Al_2O_3–BaO–La_2O_3 Glass Blends

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The thermal and crystalline properties of the sintered Phlogopite mica/SiO_2–B_2O_3–Al_2O_3–BaO–La_2O_3 glass blends with the weight fraction of mica from 0 to 100% have been investigated in this paper. A small amount of Phlogopite mica addition raises the coefficient of thermal expansion (CTE) of the sintered phlogopite mica/SiO_2–B_2O_3–Al_2O_3–BaO–La_2O_3 glass blends. However, the CTE of the blends decreases at mica contents higher than 10 wt%. Besides, the CTE of the blends can be modified by adjusting the weight fraction of mica. In this study, the range of CTE varies from 9.7 to 18.1×10^{-6} ºC^{-1}. The crystalline phases of $BaSiO_3$ and $BaAl_2Si_2O_8$ are found in the sintered Phlogopite mica/SiO_2–B_2O_3–Al_2O_3–BaO–La_2O_3 glass blends. The amount of $BaSiO_3$ phase in the sintered blends is observed at a maximum with mica content at 10 wt%. Additionally, the amount of $BaAl_2Si_2O_8$ phase increases as the mica content increases.

Introduction

The glass-ceramic is widely used in SOFC as sealing material due to its exceptional properties. A suitable glass ceramic sealant for SOFC must suffice several basic requirements, such as compatible CTE, high temperature stability, chemical resistibility, long term durability, etc., while packing with other components. Recently, in related studies of seals for SOFC applications, several key research topics such as: development of new materials, study on sealing mechanism between sealant and other stack components, as well as long term stability and compatibility of sealant with adjacent components, have been intensively investigated (1). The aluminum silicate glass, when it contains a certain amount of BaO, yields a high compatible CTE to that of other SOFC stack components, and thus the BaO–Al_2O_3–SiO_2 system glasses are commonly used as high temperature seals for SOFC (2-4). Lara et al. (5, 6) reported that the CTE of RO–BaO–SiO_2 glasses system were in the range of $8.5\sim12\times10^{-6}$ ºC^{-1}. However, barium in the glass is prone to react with chromium, one of the major compositions of metallic interconnect, to form $BaCrO_4$ at elevated temperatures. As $BaCrO_4$ preferentially accumulates at interface and its CTE (7) is much higher than that of glass and interconnect, crack could be induced in the adhesive layer after long term operation and cause failure of the sealing. For those aforementioned reasons, one possible solution is to reduce or to replace the content of barium in the glass system (8). Besides, hybrid sealant made of glass and mica has been addressed by many papers (9-12). The advantages of using mica as the high-temperature sealant include no need for a sealing process at high temperature and no need of CTE compatibility with adjacent components. However, poor stability and high leak rate of mica at elevated temperatures are still under evaluation.

Chou et al. (13) reported that the low leak rate could be achieved by introducing glass to mica to form a hybrid seal, and they made the mica/glass hybrid seal as a sandwich structure. In this study, we investigate the characteristics of the sintered Phlogopite mica/SiO_2–B_2O_3–Al_2O_3–BaO–La_2O_3 glass blends with the weight fraction of mica from 0 to 100%. Physical, thermal, microstructural, and crystalline properties of Phlogopite mica/SiO_2–B_2O_3–Al_2O_3–BaO–La_2O_3 glass blends are presented hereafter.

Experimental Procedures

Materials and Sample Preparation

Phlogopite mica and GC9 glass were employed in this study. Phlogopite mica sheets ($KMg_3(AlSiO_{10})(OH)_2$) were purchased from Cogebi, Inc. (Dover, NH, USA). The GC9 glass is developed by Institute of Nuclear Energy Research (INER) for high temperature seals for SOFC stacks (14-17). Its main composition includes 25~40 mol% SiO_2, 2~15 mol% B_2O_3, 1~15 mol% Al_2O_3, 25~40 mol% BaO, 0.1~15 mol% La_2O_3, 2~15 mol% CaO, and 0~5 mol% ZrO_2.

Phlogopite mica sheet was milled and then sieved to fine powders ($\phi \leq 45$ μm) after heat treatment at 850ºC for 6 hours. The purities of all glass raw materials are higher than 99.5%. Fabrication processes for the glass include batching, mixing, melting, quenching, and annealing. All of the starting chemical reagents of GC9 glass were weighed, with accuracy to the thousandths after the decimal point, on a digital balance. The weighed chemical reagents were fully mixed by a 3D mixer before melting. The molten processes of GC9 glass are conducted with an electric furnace and heated up from room temperature to 1550ºC with a heating rate of 5ºC/min. After 10 hours at the smelting temperature, the melt was cast onto a graphite plate and immediately annealed at 680ºC for 8 hours to release the residual thermal stresses. After furnace cooling to room temperature, the glass ingot was milled to fine powders ($\phi \leq 45$ μm). The Phlogopite mica/GC9 glass blend specimen was prepared by mixing GC9 glass powder with Phlogopite mica at 0.033, 0.05, 0.1, 0.2, and 0.25 weight fractions, respectively. Then the fully mixed powder was cold pressed in a mold with a pressure of 270 MPa and held for 60 seconds, then the pellet (8 mm in diameter and 20 mm in height) was removed from mold and put into a furnace for sintering at 830ºC for 1 hour and subsequent isothermal crystallization at 750ºC for 4 hours.

Density and CTE Measurement

The density of the sintered Phlogopite/GC9 glass specimens was measured by Archimedes' method using an electronic balance (Mettler H33AR, Switzerland). Every single data was calculated from the average value of at least three specimens. The coefficient of thermal expansion (CTE) for sintered Phlogopite mica/GC9 glass blends was also measured in this study. The sintered Phlogopite/GC9 glass specimens were ground carefully to get the specimen with a parallel of upper and lower surface. Then the specimen for CTE measurement was placed into a high temperature dilatometer (SETARAM DHT 2050kN, France) and heated from room temperature to 900ºC with a heating rate of 5ºC/min. During measurement, the load applied onto sample was about 1 g and Argon was used as the inert atmosphere. The thermal expansion curve was recorded by a digital recorder during the measurement.

Observation of Shape Change at Elevated Temperatures

The powder of Phlogopite mica/GC9 glass blend at mica weight fractions of 0, 0.033, 0.05, 0.1, 0.2, 0.25, and 1.0 was cold pressed in a mold with a pressure of 270 MPa and held for 60 seconds, respectively. The pellet (8 mm in diameter and 8 mm in height) was removed from mold and put into a furnace, then heated from room temperature to 900ºC with a heating rate of 5ºC/min. The shape change of the specimen was recorded using a CCD during the heating process.

Microstructure Observation and XRD Analysis

The sintered Phlogopite mica/GC9 glass blend specimens were carefully cut, mounted, ground, polished, and then coated with a thin Pt film onto the specimen surface before SEM observation and elemental analysis. These examinations were carried out using a Hitachi S-4800 scanning electron microscope (SEM) (Chiyoda-ku, Tokyo, Japan), equipped with an energy dispersive X-ray spectrometer (EDS) to determine the elemental compositions. Acceleration voltage of 15 kV and second electron image were employed in the observation. In addition, XRD analysis was also carried out in this study to identify the crystalline phases of the sintered Phlogopite mica/GC9 glass blends. X-ray diffraction patterns of the sintered Phlogopite mica/GC9 glass blends were determined using an X-ray diffractometer (Burker D8 Discover, Germany) equipped with CuK_{α} (1.5406Å) radiation. The operation voltage and current were 40 kV and 40 mA, respectively. The scanning range was 2θ=15º~60º and the scanning speed was 4 º/min.

Results and Discussion

Phlogopite mica shows high thermal resistibility and compressibility, whereas GC9 glass has a high CTE, and thermal and chemical stability. Both of the Phlogopite mica and GC9 glass are suitable sealing materials for SOFC applications. In the present study, physical, thermal, microstructural, and crystalline properties of the sintered Phlogopite mica/GC9 glass blends with the weight fraction of mica from 0 to 100% have been examined.

TABLE I. Characteristics of the sintered Phlogopite mica/GC9 glass blends.

Weight fraction of mica	**Shrinkage (V/V_0–1)**	**Weight loss (W/W_0–1)**	**Density (g/cm^3)**	**CTE† ($\times 10^{-6}$ ºC^{-1})**
0	–20.1%	–0.3%	4.34	10.6
0.033	–11.4%	–0.4%	4.27	14.4
0.05	–6.0%	–1.1%	4.22	15.3
0.1	–7.0%	–1.5%	3.86	18.1
0.2	–9.7%	–1.0%	3.47	11.8
0.25	–4.1%	–0.9%	3.36	9.7
1	+3.0%	–1.3%	2.11	11.1

† Data were calculated at 750ºC.

Table 1 lists the volume shrinkage, weight loss, density, and CTE of mica/GC9 glass blends after sintering at 830ºC for 1 hour and subsequent crystallization at 750ºC for 4 hours. The volume shrinkage of GC9 glass powder after sintering is about 20%, whereas the volume expansion of mica after sintering is about 3%. The densities of Phlogopite mica and GC9 glass are 2.11 and 4.34 g/cm^3, respectively. However, the density of Phlogopite mica/GC9 glass blends does not linearly decrease as the content of mica increases as shown in Figure 1. A lower density of Phlogopite mica/GC9 glass blends implies that some extra volume could be produced during the sintering/crystallization processes. Furthermore, the measured data indicate that there would be a reverse point for CTE and/or shrinkage around a mica weight fraction of 10%.

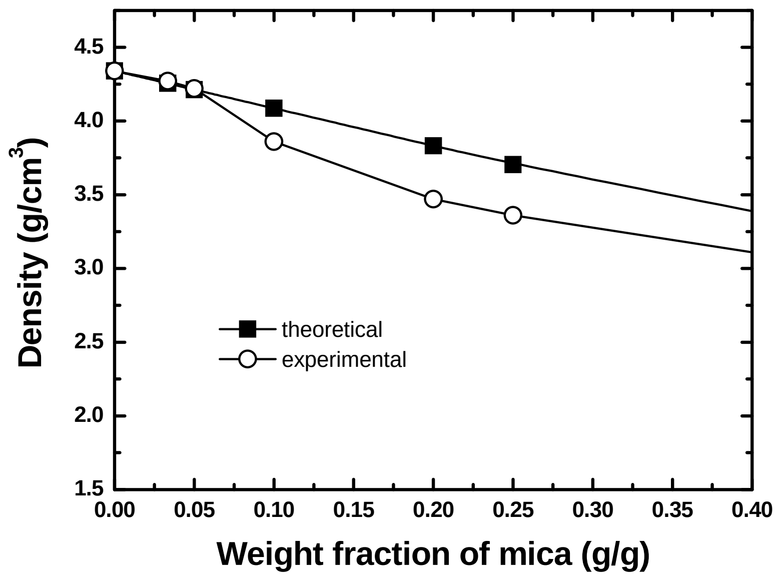

Figure 1. Theoretical and experimental densities of the Phlogopite mica/GC9 glass blends at different weight fractions of mica.

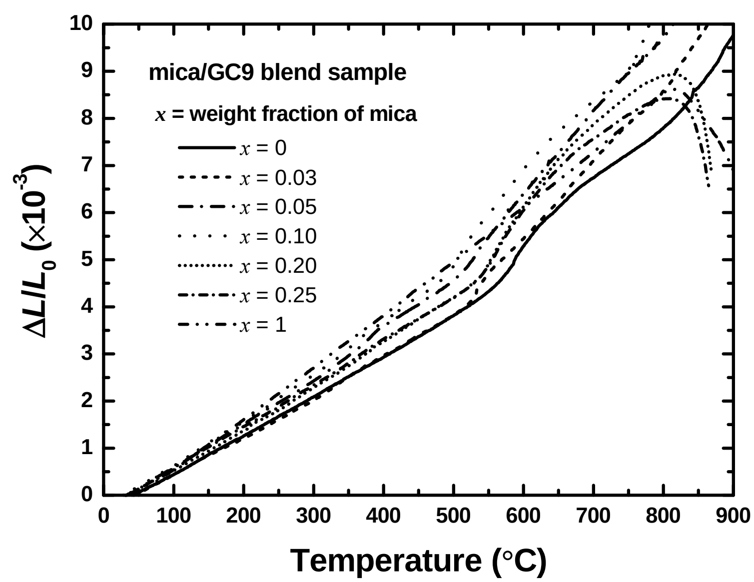

Figure 2. Thermal expansion curves of the Phlogopite mica/GC9 glass blends at different weight fractions of mica.

Figure 2 shows the thermal expansion curves of the hybrid Phlogopite mica/GC9 glass blends with different weight fractions of mica. The CTE values are calculated from the elongation data and the formula can be written as:

$$CTE = \frac{\Delta L}{L_0} \times \frac{1}{\Delta T} \quad [1]$$

where L is sample length, ΔT is temperature difference. The CTEs of GC9 glass in sintered form and Phlogopite mica at 750ºC are 10.6×10^{-6} ºC^{-1} and 11.1×10^{-6} ºC^{-1}, respectively. Note that the thermal expansion curves are downward at temperatures higher than 800ºC for the mica weight fraction higher than 0.2. This phenomenon is probably attributed to the sintering process instead of the softening of samples. It is also found that the CTE of Phlogopite mica/GC9 glass blends can be modified by adjusting the weight fraction of mica. In this study, the range of CTE varies from 9.7 to 18.1×10^{-6} ºC^{-1}.

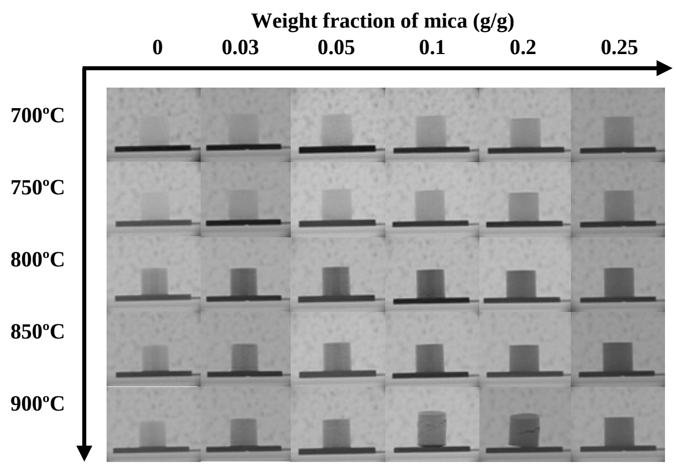

Figure 3. Shape evolution of the Phlogopite mica/GC9 glass blends with different weight fractions of mica at elevated temperatures.

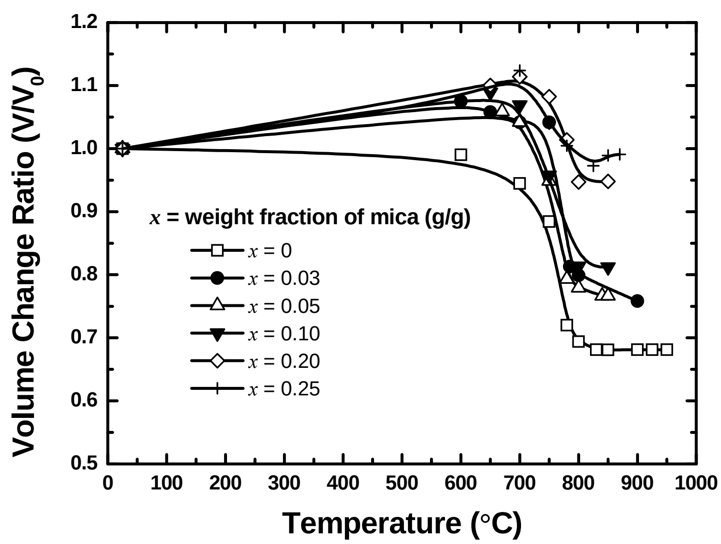

Figure 4. Volume change of the Phlogopite mica/GC9 glass blends at different weight fractions of mica during sintering.

A series of photographs correspond to the shape evolution of the Phlogopite mica/GC9 glass blends with different weight fractions of mica at elevated temperatures as shown in Figure 3. The wetting and adhesion behaviors between specimen and substrate are also revealed from the observation. As shown in Figure 3, the shape of specimen is symmetrical during sintering; thus the volume change of the Phlogopite mica/GC9 glass blends is evaluated. Figure 4 illustrates the volume change of the Phlogopite mica/GC9 glass blends at different weight fractions of mica during sintering. It indicates that the volume of specimen shrinks dramatically around the sintering temperature of 700ºC. Furthermore, the sintering temperature of the Phlogopite mica/GC9 glass blends increases slightly as the weight fraction of mica increases. It would be attributed to the increases of interfaces between mica and GC9 glass. On the contrary, the volume shrinkage of the Phlogopite mica/GC9 glass blends as well as its density decreases as the weight fraction of mica increases. This is in good agreement to Figure 1.

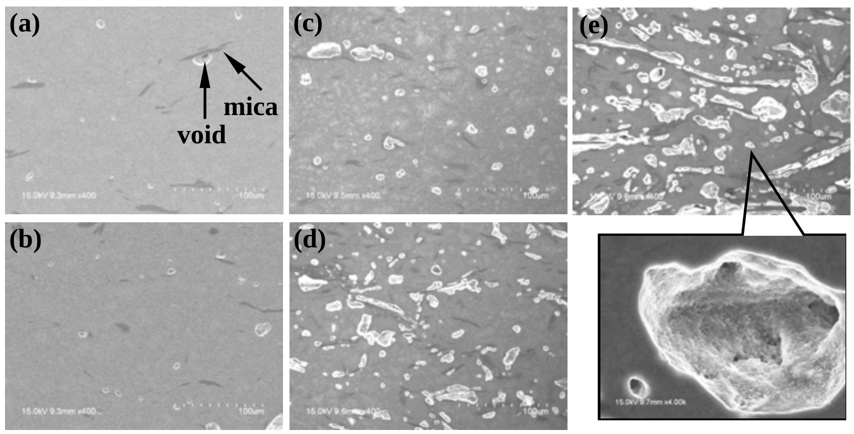

Figure 5. Micrographs of the sintered Phlogopite mica/GC9 glass blends at mica weight fractions of (a) 0.033, (b) 0.05, (c) 0.1, (d) 0.2, and (e) 0.25. (400×)

Figures 5(a)~(e) show the micrographs of the sintered Phlogopite mica/GC9 glass blends (magnification=400×) at mica weight fractions of 0.033, 0.05, 0.1, 0.2, and 0.25, respectively. The amount of voids and void sizes increase as the content of mica increases. Additionally, most of the voids are closed pores and prone to form on the interfaces of mica and GC9 glass. It is found that the chemical reactions would occur on the interfaces between mica and GC9 glass at elevated temperatures. Hence, the negative deviation in the density of the sintered Phlogopite mica/GC9 glass blends is attributed to the void formation caused by the interfacial chemical reactions between mica and GC9 glass at elevated temperatures.

The microstructure of the GC9 glass powder in sintered form is shown in Figure 6(a), and the micrographs of the sintered Phlogopite mica/GC9 glass blends (magnification= 4000×) at mica weight fractions of 0.033, 0.05, 0.1, 0.2, and 0.25, respectively, are shown in Figures 6(b)~(f). The sintered blends retain a lot of pores within the matrix, whereas the specimen is almost fully sintered. It is found that the $BaSiO_3$ phase formed near the pores and its amount increases with mica additions. Figure 7 shows the XRD patterns of the sintered Phlogopite mica/GC9 glass blends with different weight fractions of mica. The peaks marked “1”, “2”, “3”, and “4” represent the corresponding crystal phases of $BaSiO_3$ (Orthorhombic), $BaAl_2Si_2O_8$ (Monoclinic), Al_2SiO_5 (Triclinic), and mica (Monoclinic), respectively. According to the XRD analysis, the amount of $BaSiO_3$ phase increases with mica additions and is observed at a maximum while the weight fraction of mica is around 10% in the sintered Phlogopite mica/GC9 glass blends. In addition, the amount of $BaAl_2Si_2O_8$ phase increases with mica additions in the sintered Phlogopite mica/GC9 glass blends. Among the crystalline phases, the CTE of $BaSiO_3$ phase is larger than that of $BaAl_2Si_2O_8$ phase (3). Therefore, formation of $BaSiO_3$ phase is positive to raise the CTE of the sintered Phlogopite mica/GC9 glass blends. From Table 1, it can be found that the CTE of the sintered Phlogopite mica/GC9 glass blends is affected by the variety of crystalline phases. The amount and variety of crystalline phases of the sintered Phlogopite mica/GC9 glass blends are affected by the mica additions. Moreover, the void generation due to the chemical reactions on the interfaces of mica and GC9 glass would be a major effect on thermal property of the sintered Phlogopite mica/GC9 glass blends.

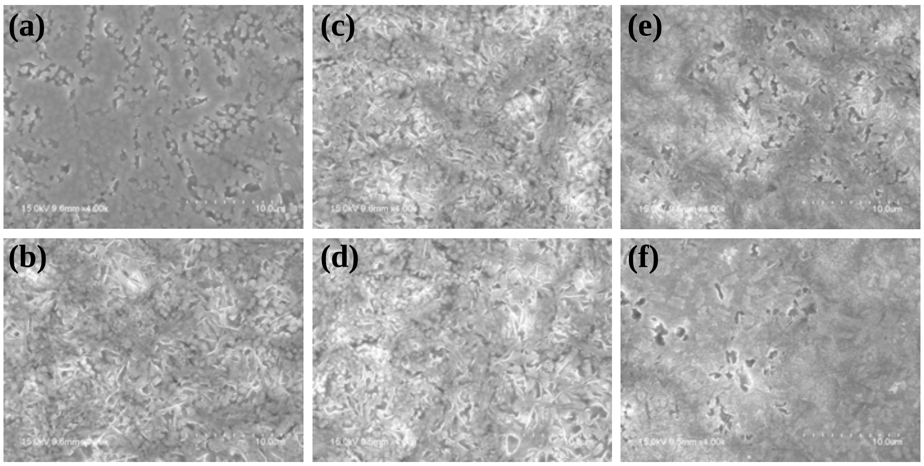

Figure 6. Micrographs of the sintered Phlogopite mica/GC9 glass blends at mica weight fractions of (a) 0, (b) 0.033, (c) 0.05, (d) 0.1, (e) 0.2, and (f) 0.25. (4,000×)

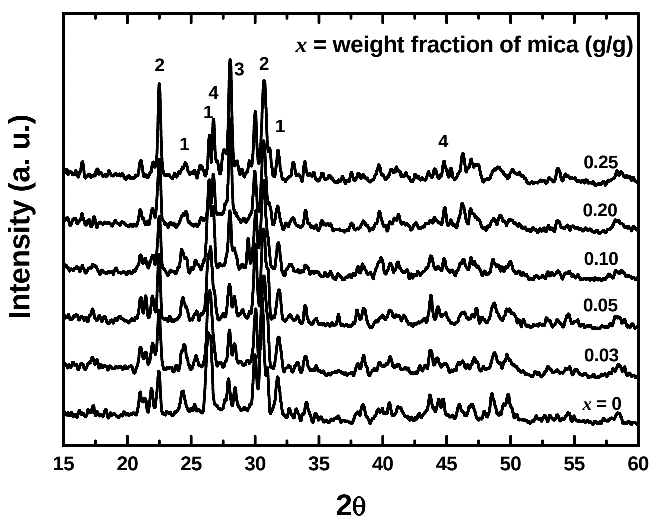

Figure 7. XRD patterns of the Phlogopite mica/GC9 glass blends at different weight fractions of mica.

Conclusions

Physical, thermal, and crystalline properties of the sintered Phlogopite mica/SiO_2–B_2O_3–Al_2O_3–BaO–La_2O_3 glass blends with weight fraction of mica from 0 to 100% have been systematically investigated. The CTE of Phlogopite mica/GC9 glass blends can be modified by adjusting the weight fraction of mica. A small amount of Phlogopite mica additions raises the coefficient of thermal expansion (CTE) of the sintered Phlogopite mica/SiO_2–B_2O_3–Al_2O_3–BaO–La_2O_3 glass blends. However, the CTE of the blends decreases at mica contents higher than 10 wt%. In this study, the range of CTE varies from 9.7 to 18.1×10^{-6} ºC^{-1}. It is found that voids are formed on the interface between mica and GC9 glass at elevated temperatures. The amount of voids and void sizes increases as the content of mica increases and most of the voids are closed pores. The crystalline phases of $BaSiO_3$ and $BaAl_2Si_2O_8$ are found in the sintered Phlogopite mica/SiO_2–B_2O_3–Al_2O_3–BaO–La_2O_3 glass blends. The amount of $BaSiO_3$ phase increases with mica additions and is observed at a maximum with the weight fraction of mica around 10% in the sintered Phlogopite mica/GC9 glass blends. In addition, the amount of $BaAl_2Si_2O_8$ phase increases with mica additions in the sintered Phlogopite mica/GC9 glass blends.

Acknowledgments

The authors would like to acknowledge Mr. T. –S. Lee and Mr. T. –Y. Yung for their technical support in this study.

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附錄三

219th ECS Meeting - Montreal, QC, Canada

May 1 - May 6, 2011
PROGRAM INFORMATION

B7 - Solid Oxide Fuel Cells XII (SOFC-XII)

Monday, May 2, 2011
Room 517A, Level 5
SOFC Plenary Session
Co-Chairs: Subhash Singhal and Koichi Eguchi

Time	Progr#	Title and Authors
08:00		Introductory Remarks - Subhash Singhal (20 Minutes)
08:20	644	Recent Developments in the SECA Program S. D. Vora (U.S. Department of Energy, National Energy Technology Laboratory)
08:40	645	Status of National Project for SOFC Development in Japan K. Hosoi, M. Ito, and M. Fukae (New Energy and Industrial Technology Development Organization)
09:00	646	European SOFC Technology - Status and Trends R. Steinberger-Wilckens (Forschungszentrum Jülich GmbH)
09:20	647	Solid Oxide Fuel Cells Canada NSERC Strategic Research Network V. I. Birss (University of Calgary), A. Petric (McMaster University), and S. Thomas (University of Calgary)
09:40		Intermission (20 Minutes)
10:00	648	Recent Results in Solid Oxide Fuel Cell Development at Forschungszentrum Juelich R. Steinberger-Wilckens, L. Blum, H. Buchkremer, L. De Haart, M. Pap, and R. Steinbrech (Forschungszentrum Jülich GmbH)
10:20	649	Development of Solid Oxide Fuel Cells at Versa Power Systems B. Borglum, E. Tang, and M. Pastula (Versa Power Systems Ltd.)
10:40	650	Recent Progress in Development and Manufacturing of SOFC at Topsoe Fuel Cell A/S and Risø DTU N. Christiansen, H. Holm-Larsen, S. Primdahl (Topsoe Fuel Cell A/S), M. Wandel (Risø DTU), S. Ramousse (Technical University of Denmark), and A. Hagen (Risø DTU)
11:00	651	CFCL's BlueGen Product R. J. Payne, J. Love, and M. Kah (Ceramic Fuel Cells Limited)
11:20	652	Status of Hexis' SOFC Stack Development and the Galileo 1000 N Micro-CHP System A. Mai, B. Iwanschitz, U. Weissen, R. Denzler, D. Haberstock, V. Nerlich, and A. Schuler (Hexis Ltd.)
11:40	653	Development of Residential SOFC CHP System with Flatten Tubular Segmented-In-Series Cells Stack H. Yoshida (Tokyo Gas Co., Ltd.), T. Seyama (Gastar Co., Ltd.), T. Sobue (Rinnai Corporation), and S. Yamashita (Kyocera Corporation)

SOFC Stacks and Systems I
Co-Chairs: Robert Steinberger-Wilckens and Shailesh Vora

Time	Progr#	Title and Authors
14:00	654	Development of SOFC-GT Combined Cycle System with Tubular Type Cell Stack S. Yoshida, T. Kabata, M. Nishiura, S. Koga (Mitsubishi Heavy Industries, Ltd), K. Tomida (Mitsubishi Heavy Industry, Ltd.), K. Miyamoto, Y. Teramoto, N. Matake, H. Tsukuda, S. Suemori, Y. Ando, and Y. Kobayashi (Mitsubishi Heavy Industries, Ltd)
14:20	655	Status of SOFC Demonstration Unit with 10 kW Stack M. Halinen, M. Rautanen, J. Saarinen, J. Pennanen, A. Pohjoranta, J. Kiviaho (VTT Technical Research Centre of Finland), M. Pastula, B. Nuttall, C. Rankin, and B. Borglum (Versa Power Systems Ltd.)
14:40	656	Progress on SOFC Power Generation Module and System Developed by NTT, SPP and THG K. Hayashi, A. Miyasaka (Nippon Telegraph and Telephone Corporation), N. Katou (NTT Corp.), Y. Yoshida, H. Arai (Nippon Telegraph and Telephone Corporation), M. Hirakawa (Sumitomo Precision Products Co. Ltd.), H. Uwani, S. Kashima, H. Orisima (Sumitomo Precision Products Co., Ltd.), S. Kurachi, A. Matsui, K. Katsurayama, and E. Tohma (Toho Gas Co., Ltd.)
15:00	657	Manufacturing and Market-Oriented Development of SOFC Generators at SOFCpower SpA M. Bertoldi (SOFCpower SpA), O. Bucheli (HTceramix SA), S. Modena (SOFCpower SpA), D. Larrain (HTceramix SA), and A. Ravagni (SOFCpower SpA)
15:20	658	Latest Update on Delphi's Solid Oxide Fuel Cell Stack for Transportation and Stationary Applications S. Mukerjee, K. Haltiner, R. Kerr (Delphi Corporation), V. Sprenkle, and J. Kim (Pacific Northwest National

Laboratory)

15:40 659 Metal Supported Solid Oxide Fuel Cells and Stacks for Auxilary Power Units - Progress, Challenges and Lessons Learned A. Ansar, J. Arnold, P. Szabo, Z. Ilhan, D. Soysal, R. Costa (German Aerospace Center), A. Zagst (ElringKlinger AG), M. Gindrat (Sulzer Metco AG), and T. Franco (Plansee SE Innovation Services)

16:00 955 Product Development for SOFC and SOE Applications A. Glauche, T. Betz (Kerafol GmbH), and M. Ise (Siemens AG)

Room 516C, Level 5

SOFC Electrolyte Materials, Processing and Performance

Co-Chairs: Eric Wachsman and Harumi Yokokawa

Time	Progr#	Title and Authors
14:00	661	Strain Effect on Oxygen Migration in Yttria-Stabilized Zirconia W. Araki, M. Kuribara, and Y. Arai (Saitama University)
14:20	662	Fabrication and Ionic Conducting Properties of Superlattices Based on Ceria and Zirconia D. Pergolesi (National Institute for Materials Science), A. Tebano (University of Roma Tor Vergata), F. Fabbri (National Institute for Materials Science), G. Balestrino, S. Licoccia (University of Roma Tor Vergata), and E. Traversa (National Institute for Materials Science)
14:40	663	Chemical Expansion and Frozen-In O Vacancies in Pr-Doped Ceria Y. Kuru, S. R. Bishop, J. Kim, B. Yildiz, and H. L. Tuller (Massachusetts Institute of Technology)
15:00	664	Mechanical, Electrical, and Optical Properties of Pr-CeO_2 Solid Solutions S. R. Bishop, J. Kim, D. Chen, Y. Kuru, T. Stefanik, and H. L. Tuller (Massachusetts Institute of Technology)
15:20	665	Mechanical Properties of $Ce_{0.9}Gd_{0.1}CeO_{2-\delta}$ at High Temperatures under Controlled Atmospheres T. Kushi, K. Sato, A. Unemoto, K. Amezawa, and T. Kawada (Tohoku University)
15:40	666	Oxygen Diffusion in Ordered/Disordered Double Perovskites A. Tarancón (Catalonia Institute for Energy Research), A. Chroneos, D. Parfitt, and J. Kilner (Imperial College London)
16:00	774	Effect of Doped Ceria Interlayer on Low Temperature SOFC Performance Y. Kim, T. M. Gür, and F. B. Prinz (Stanford University)

Room 517A, Level 5

SOFC Poster I (Cathode, Interconnection and Seals)

Co-Chairs: Fanglin Chen and Nguyen Minh

Time	Progr#	Title and Authors
o	668	In situ Sinterable Cathode for Solid Oxide Fuel Cells H. Kim (Yeungnam University), Y. Park (Research Institute of Industrial Science and Technology), J. Kim, and H. Jin (Yeungnam University)
o	669	Aerosol Jet Printing and Microstructure of SOFC Electrolyte and Cathode Layers A. M. Sukeshini, P. Gardner (Wright State University), F. Meisenkothen, T. Jenkins (UES Corporation), R. Miller, M. Rottmayer, and T. L. Reitz (Air Force Research Laboratory)
o	670	Effect of Gel Viscosity on the LSM Films Supported on Metallic Substrate L. Conceição, N. Ribeiro, and M. M. Souza (Universidade Federal do Rio de Janeiro)
o	671	Nanosized Ceria Modified $GdBaCo_2O_{5+\delta}$ Cathode for IT-SOFC B. Wei, Z. Lü, D. Jia, L. He, X. Huang, Y. Zhang, and W. Su (Harbin Institute of Technology)
o	672	Pr Doped Ceria and $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_3$ Composite Cathode for Solid Oxide Fuel Cell M. Chen and S. Cheng (National Taiwan University)
o	673	Effect of the Strontium Content on the Electrochemical Performance of the Perovskite-Type $Pr_{1-x}Sr_xFe_{0.8}Co_{0.2}O_3$ R. Pinedo, I. Ruiz de Larramendi, D. Jimenez de Aberasturi, J. Ruiz de Larramendi, M. Arriortua, and T. Rojo (Universidad del País Vasco)
o	674	Cooperative Investigations on Degradation of Cathode Materials in Segment-In-Series Cells by MHI H. Yokokawa, H. Kishimoto, K. Yamaji, T. Horita (National Institute of Advanced Industrial Science and Technology), T. Watanabe, T. Yamamoto (Central Research Institute of Electric Power Industry), K. Eguchi, T. Matsui (Kyoto University), K. Sasaki, Y. Shiratori (Kyushu University), T. Kawada, K. Sato, T. Hashida, A. Unemoto (Tohoku University), T. Kabata (Mitsubishi Heavy Industries, Ltd), and K. Tomida (Mitsubishi Heavy Industry, Ltd.)
o	676	Nanofibers for Solid Oxide Fuel Cell Cathode M. Zhi (US Department of Energy), N. Mariani (West Virginia University), K. Gerdes (National Energy Technology Laboratory), R. Gemmen (U.S. Department of Energy), and N. Wu (US Department of Energy)
o	677	Silver Nanomesh as a Cathode for Solid Oxide Fuel Cells J. Shim (Korea University), Y. Kim, J. Park, and F. B. Prinz (Stanford University)
o	678	Effect of Polarization on Platinum Deposition at LSM/YSZ Interfaces K. Yamaji, T. Shimonosono, H.

Kishimoto, M. E. Brito, T. Horita, D. Cho, M. Izuki, F. Wang, and H. Yokokawa (National Institute of Advanced Industrial Science and Technology)

- 679 Active and Resistive Zones of the Oxygen Reduction Reaction Monitored by Voltage-Driven ^{18}O Tracer Incorporation M. Kubicek, A. Opitz, A. Schintlmeister, T. Frömling, H. Hutter, and J. Fleig (Vienna University of Technology)
- 680 Development of Purification Methods of Rare Earth Compounds for Preparation of More Cost Effective Solid Oxide Fuel Cell Cathodes R. Kanarbik, P. Möller, I. Kivi, K. Tamm, and E. Lust (University of Tartu)
- 681 Nanostructured LSCF Coatings by Suspension Plasma Spraying D. Soysal and A. Ansar (German Aerospace Center)
- 682 Study of $Ca_{3-x}Bi_xCo_4O_{9+\delta}$(0 < x (less than or equal to) 0.5) as Novel Cathodes for IT-SOFCs J. Zou, J. Park, H. Yoon, S. Choi, and J. Chung (Pohang University of Science and Technology)
- 683 Material Stability and Cation Transport of $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-\delta}$ in SOFC Cathode Conditions M. Oh, A. Unemoto, K. Amezawa, and T. Kawada (Tohoku University)
- 684 Influence of SO_2 on the Long-Term Durability of SOFC Cathodes R. Liu, S. Taniguchi, Y. Shiratori, K. Ito, and K. Sasaki (Kyushu University)
- 685 Detailed Electrochemical Analysis of High-Performance Nanoscaled $La_{0.6}Sr_{0.4}CoO_{3-\delta}$ Thin Film Cathodes J. Hayd (Karlsruher Institut für Technologie), U. Guntow (Fraunhofer-Institut für Silicatforschung), and E. Ivers-Tiffée (Karlsruher Institut für Technologie)
- 686 Electrode and Electrolyte Layers for Solid Oxide Fuel Cells Applied by Physical Vapor Deposition (PVD) S. Uhlenbruck, R. Nédélec, D. Sebold, H. Buchkremer, and D. Stöver (Forschungszentrum Jülich GmbH)
- 687 Comparative Electrical Properties of Electrosprayed LSCF Cathode Films for IT-SOFCs for Different Morphologies and Cobalt Contents D. Marinha, L. Dessemond, and E. Djurado (Grenoble INP)
- 688 Fabrication and Characterization of $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-\delta}$-Yttria Stabilized Zirconia Composites Cathode Prepared by Infiltration Method M. Han, Z. Liu, and J. Qian (China University of Mining and Technology)
- 689 Exploring Mixed Protonic/Electronic Conducting Oxides as Cathode Materials for Intermediate Temperature SOFCs Based on High Temperature Proton Conductor Electrolytes E. Fabbri, L. Bi, D. Pergolesi, and E. Traversa (National Institute for Materials Science)
- 690 Investigation of the Particle Size Change of a La(Ni, Fe)O_3 Cathode Y. Yoshida, R. Chiba, M. Yokoo, K. Hayashi, H. Orui, and H. Arai (Nippon Telegraph and Telephone Corporation)
- 691 A Novel Lamellar Structure for High-Performance Cobalt-Iorn Based Cathode for IT-SOFC Z. Tong, Y. Yin, Y. Guo, J. Yin, L. Sun, and Z. Ma (Shanghai Jiao Tong University)
- 692 Simple Infiltrated Microstructure Polarization Loss Estimation (SIMPLE) Model Predictions of Today and Tomorrow's SOFC Nano-Composite SOFC Cathodes L. Wang and J. D. Nicholas (Michigan State University)
- 693 Nanocomposite Cathode Materials for Intermediate Temperature Solid Oxide Fuel Cells T. Kharlamova, S. Pavlova, V. Sadykov, Y. Bespalko, T. A. Krieger, V. Pelipenko, V. Belyaev (Boreskov Institute of Catalysis), Y. Okhlupin, N. Uvarov (Institute of Solid State Chemistry and Mechanochemistry), and A. Smirnova (Eastern Connecticut State University)
- 694 Microstructural Aspects of Cation Inter-Diffusion across the LSCF/GDC Interface M. E. Brito, M. Izuki, K. Yamaji, H. Kishimoto, T. Shimonosono, T. Horita, and H. Yokokawa (National Institute of Advanced Industrial Science and Technology)
- 696 Influence of Cathode Thickness on the Oxygen Reduction Kinetics at the Intermediate Temperature SOFC Cathodes I. Kivi, I. Drovtar, E. Anderson, K. Tamm, G. Nurk, P. Möller, M. Vestli, R. Kanarbik, and E. Lust (University of Tartu)
- 697 Detailed Microstructure Analysis and 3D Simulations of Porous Electrodes J. Joos (Karlsruher Institut für Technologie), T. Carraro (University Heidelberg), M. Ender, B. Rüger, A. Weber, and E. Ivers-Tiffée (Karlsruher Institut für Technologie)
- 698 Firing Temperature Effect on 3D Microstructure and Performance of LSM-YSZ Composite SOFC Cathodes J. Cronin, K. Muangnapoh, Z. Patterson, K. Yakal-Kremski, and S. A. Barnett (Northwestern University)
- 699 Characterization of SOFC Cathodes Prepared by Pulse Laser Deposition F. Napolitano, L. Baqué (Centro Atómico Bariloche), S. Cho, S. Qing, H. Wang (Texas A & M University), A. Caneiro, A. L. Soldati, and A. Serquis (Centro Atómico Bariloche)
- 700 High Surface Area, Mesoporous Catalysts in Solid Oxide Fuel Cell Cathode R. Chao, P. Salvador, J. Kitchin (Carnegie Mellon University), and K. Gerdes (National Energy Technology Laboratory)
- 701 Microstructural Control of Composite Cathode by Wetting Nature of Infiltrated Solutions S. Lee, N. Miller, and A. Manivannan (U.S. Department of Energy)
- 703 Cathode Materials for $La_{26}O_{27}(BO_3)_8$ Proton Ceramic Electrolyte K. Kravchyk, E. Quarez, M. Caldes (Université de Nantes, CNRS), and O. Joubert (CNRS LTM)
- 705

Chemical, Electronic and Nanostructure Dynamics on $Sr(Ti_{1-x}Fe_x)O_3$ Thin-Film Surfaces at High Temperatures Y. Chen, W. Jung, Y. Kuru, J. Kim, H. L. Tuller, and B. Yildiz (Massachusetts Institute of Technology)

- 706 Comparison of XCT and FIB-SEM in 3D Elemental Mapping of the Composite LSM/YSZ SOFC Cathode Microstructure G. Nelson, W. Harris, J. Lombardo, J. Izzo, W. K. Chiu (University of Connecticut), P. Tanasini, M. Cantoni (Ecole Polytechnique Federale de Lausanne), J. Van Herle (Ecole Polytechnique Fédérale de Lausanne), C. Comninellis (Ecole Polytechnique Federale de Lausanne), J. Andrews, Y. Liu, P. Pianetta (Stanford Linear Accelerator Center), and Y. Chu (Brookhaven National Laboratory)
- 707 Potential and Limitation of Application of Pulsed Laser Deposited Nanostructure LSC Thin Film Cathode to YSZ Electrolyte SOFC J. Son, H. Noh, D. Myung, J. Hwang, H. Lee, and J. Lee (Korea Institute of Science and Technology)
- 708 Mechanical Properties of $La_{0.6}Sr_{0.4}Co_{1-y}Fe_yO_{3-\delta}$ under Various Temperatures and Oxygen Partial Pressures Y. Kimura, T. Kushi, S. Hashimoto, S. Watanabe, K. Amezawa, T. Kawada, Y. Fukuda, A. Unemoto, K. Sato, K. Yashiro, J. Mizusaki, and T. Hashida (Tohoku University)
- 709 Cathode Contact Materials for Solid Oxide Fuel Cells M. Tucker, L. Cheng, and L. DeJonghe (Lawrence Berkeley National Laboratory)
- 710 Characterization of Sr and Ba-Doped $LaCrO_3$ Powders Synthesized by EDTA Method A. Silva, A. Rocco, and M. M. Souza (Universidade Federal do Rio de Janeiro)
- 711 Lanthanum Chromite Based Ceramic and Glass Composite Interconnects for Solid Oxide Fuel Cells S. Lee (Korea Institute of Energy Research), S. Pi (Korea Advanced Institute of Science and Technology), J. Lee, T. Lim, S. Park, R. Song (Korea Institute of Energy Research), C. Park (Korea Advanced Institute of Science and Technology), and D. Shin (Korea Institute of Energy Research)
- 712 Synthesis and Electrical Properties of Strontium Titanate-Based Materials for Solid Oxide Fuel Cells B. Park, J. Lee, S. Lee, T. Lim, S. Park, R. Song, and D. Shin (Korea Institute of Energy Research)
- 713 Anomalous Sintering Behavior during Sintering Process of $(Sr_{0.7}La_{0.3})_{1-x}TiO_3$ Perovskites (0 {less than or equal to} x {less than or equal to} 0.12) Synthesized by the Pechini Method M. Mori (Central Research Institute of Electric Power Industry) and T. Itoh (AGC Seimi Chemical Co. Ltd.)
- 714 PCFC's Interconnect Design Optimization S. Sailler, J. Deseure, O. Doche (CNRS Grenoble INP-UJF), and Y. Bultel (Université Joseph Fourier)
- 715 High-Temperature Stress-Rupture Properties of a Ferritic Steel for Solid Oxide Fuel Cell Interconnect Y. Chiu and C. Lin (National Central University)
- 717 Oxidation Resistance and Mechanical Properties of ZMG232L and Improved Fe-Cr Ferritic Alloys for SOFC Interconnects T. Uehara, N. Yasuda, S. Tanaka, and K. Yamamura (Hitachi Metals, Ltd.)
- 718 Characterization of Vaporization Rates on SOFC Interconnect Alloys M. Casteel and D. Lewis (Rensselaer Polytechnic Institute)
- 719 Method to Quantify Chromium Evaporation from SOFC Balance of Plant Components O. Thomann, M. H. Pihlatie (VTT Technical Research Centre of Finland), J. Schuler (Ecole Polytechnique Fédérale de Lausanne), O. Himanen, and J. Kiviaho (VTT Technical Research Centre of Finland)
- 720 Metallic Seals: A Possible Alternative Solution for High Temperature Steam Electrolysis M. Reytier, L. Bruguière (Commissariat à l'Energie Atomique), M. Lefrancois (Garlock France), and J. Besson (Centre des Matériaux, CNRS)
- 721 Chemical Interaction of $AO-SiO_2-B_2O_3-La_2O_3$ (A= Mg, Ca, Sr, Ba) Glass Sealants with High Temperature and Low Temperature Electrolytes for SOFC G. Kaur, O. Pandey, and K. Singh (Thapar University)

Tuesday, May 3, 2011

Room 517A, Level 5

SOFC Stacks and Systems II

Co-Chairs: Karl Foger and Mark Williams

Time	Progr#	Title and Authors
08:00	723	Long-Term Operation of Planar Type SOFC Stacks L. De Haart and I. Vinke (Forschungszentrum Jülich GmbH)
08:20	724	Post-Test Characterization of an SOFC Short-Stack after 17,000 Hours of Steady Operation N. Menzler, P. Batfalsky, S. Groß, V. Shemet, and F. Tietz (Forschungszentrum Jülich GmbH)
08:40	725	Current Status of NEDO Project on Durability/Reliability of Solid Oxide Fuel Cell Stacks/Systems H. Yokokawa (National Institute of Advanced Industrial Science and Technology)
09:00	726	Durability Tests of Flatten Tubular Segmented-in-Series Type SOFC Stacks for Intermediate Temperature Operation K. Horiuchi, K. Nakamura, Y. Matsuzaki, S. Yamashita (Tokyo Gas Co., Ltd.), T. Horita, H. Kishimoto, K. Yamaji, and H. Yokokawa (National Institute of Advanced Industrial Science and Technology)

09:20 727 In situ Observation of the Deformation and Mechanical Damage of SOFC Cell/Stack K. Sato, T. Sakamoto, A. Kaimai, K. Yashiro, K. Amezawa, T. Hashida, J. Mizusaki, and T. Kawada (Tohoku University)

09:40 Intermission (20 Minutes)

10:00 728 Demonstration of a Highly Efficient SOFC System with Combined Partial Oxidation and Steam Reforming D. Schimanke (staxera GmbH), O. Posdziech (EBZ GmbH), B. Mai (staxera GmbH), S. Kluge (EBZ GmbH), and C. Wunderlich (staxera GmbH)

10:20 729 System Relevant Redox Cycling in SOFC Stacks J. Brabandt, Q. Fang, D. Schimanke, M. Heinrich, B. Mai, and C. Wunderlich (staxera GmbH)

10:40 730 Portable µ-SOFC System Based on Multilayer Technology S. Reuber, M. Schneider, and M. Stelter (Fraunhofer Institute of Ceramic Technologies and Systems)

11:00 731 System Tests and Operation Control Strategies of an SOFC-CHP-Device for Field Testing R. Belitz, M. Heddrich, M. Jahn, R. Näke (Fraunhofer Institute for Ceramic Technologies and Systems), J. Paulus (Vaillant GmbH), and M. Pohl (Fraunhofer Institute for Ceramic Technologies and Systems)

11:20 732 Metal-Supported Cells with Comparable Performance to Anode-Supported Cells in Short-Term Stack Environment M. Rüttinger (Plansee SE Innovation Services), R. Mücke (Forschungszentrum Jülich GmbH), T. Franco (Plansee SE Innovation Services), O. Büchler, N. Menzler (Forschungszentrum Jülich GmbH), and A. Venskutonis (Plansee SE Innovation Services)

11:40 733 SOFC Module Material Development at Fuel Cell Energy P. Huang and H. Ghezel-Ayagh (Fuel Cell Energy, Inc.)

Room 516C, Level 5

SOFC Cathode Materials I

Co-Chairs: Nigel Brandon and Tatsuya Kawada

Time	Progr#	Title and Authors
08:00	734	CeO_2 Addition for Improving Electrochemical Behavior of $La_{1-x}Sr_xMnO_3$ Cathodes Sintered at High Temperature J. Wiff (FCO Power Corporation), M. Suzuki, and S. Suda (Japan Fine Ceramics Center)
08:20	735	High Performance LSM-Based Cathode Boosted by Stabilized Bismuth Oxide for Low to Intermediate Temperature Solid Oxide Fuel Cells K. Lee (University of Maryland), D. Jung (Samsung Advanced Institute of Technology), H. Yoon (University of Maryland), M. Camaratta, N. Sexson (University of Florida), and E. D. Wachsman (University of Maryland)
08:40	736	Quantification of Microstructural Change at the Interface between $(La,Sr)MnO_{3+\delta}$ Cathode and YSZ Electrolyte upon Discharge Operation T. Matsui, Y. Mikami, H. Muroyama, and K. Eguchi (Kyoto University)
09:00	737	Oxygen Nonstoichiometry and Defect Equilibrium of Perovskite-Type $La_{0.6}Sr_{0.4}Co_{1-y}Fe_yO_{3-\delta}$ (y=0, 0.2, 0.4, 0.5, 0.6, 0.8, 1) SOFC Cathode Materials M. Kuhn, Y. Fukuda, S. Hashimoto, K. Sato, K. Yashiro, and J. Mizusaki (Tohoku University)
09:20	738	Oxygen Non Stoichiometry in Nanocrystalline $La_{0.5}Sr_{0.5}5CoO_{3-x}$ Thin Films S. Wang (University of Houston), S. Cho, H. Wang (Texas A & M University), and A. Jacobson (University of Houston)
09:40		Intermission (20 Minutes)
10:00	739	Electrical Conductivity and Oxygen Diffusivity of Perovskite-Type Solid Solution $La_{0.6}Sr_{0.4}Co_{1-y}Fe_yO_{3-\delta}$ (y=0.2, 0.4, 0.5, 0.6, 0.8) K. Yashiro, I. Nakano, M. Kuhn, S. Hashimoto, K. Sato, and J. Mizusaki (Tohoku University)
10:20	740	Microstructure of Sol-Gel Derived Nanoscaled $La_{0.6}Sr_{0.4}CoO_{3-\delta}$ Cathodes for Intermediate-Temperature SOFCs L. Dieterle, P. Bockstaller (Karlsruher Institute für Technologie), D. Gerthsen, J. Hayd, E. Ivers-Tiffée (Karlsruher Institut für Technologie), and U. Guntow (Fraunhofer-Institut für Silicatforschung)
10:40	741	$Sm(Sr)CoO_3$ Nano Cone Cathode and Ni-Fe Metal Support for High Power Density and Reliability T. Ishihara, Y. Ju, and S. Ida (Kyushu University)
11:00	742	Performance of Metal-Supported Composite and Single-Phase Cathodes Based on LSCF and SSC J. Harris and O. Kesler (University of Toronto)
11:20	743	Low Temperature Preparation of $LaFe_{1-x}Ni_xO_3$ as New Cathode Material for SOFC: Advantage of Liquid Phase Mixing Method E. Niwa, C. Uematsu, E. Miyashita, T. Ohzeki, and T. Hashimoto (Nihon University)
11:40	744	Doped / Undoped Ceria Buffer Layers for Improved LT SOFC Performances with $Pr_2NiO_{4+\delta}$ Cathode J. Bassat, D. Mesguich, C. Ferchaud (Université de Bordeaux), Y. Zhang-Steenwinkel, F. Van Berkel (Energy Research Centre of the Netherlands), C. Aymonier (Université de Bordeaux), J. Watkins (University of Massachusetts), and J. Grenier (Université de Bordeaux)

Room 517A, Level 5

SOFC Cell Design, Testing and Performance I

Co-Chairs: Viola Birss and Teruhisa Horita

Time	Progr#	Title and Authors
14:00	745	Recent Development of Electrolyte Supported Cells with High Power Density N. Trofimenko, M. Kusnezoff (Fraunhofer Institute for Ceramic Technologies and Systems), and A. Michaelis (Fraunhofer Institute of Ceramic Technologies and Systems)
14:20	746	Development of Anode-Supported Flat-Tube Solid Oxide Fuel Cells with High Power Density S. Lee, J. Lee, T. Lim, S. Park, R. Song, and D. Shin (Korea Institute of Energy Research)
14:40	747	Medium Temperature Solid Oxide Fuel Cells Based on Supporting Porous Anode and Bilayered Electrolyte E. Lust, I. Kivi, K. Tamm, P. Möller, E. Anderson, H. Kurig, M. Vestli, and G. Nurk (University of Tartu)
15:00	748	Development of Metal-Supported Solid Oxide Fuel Cells T. Franco, M. Haydn (Plansee SE Innovation Services), R. Mücke (Forschungszentrum Jülich GmbH), A. Weber (Karlsruher Institut für Technologie), M. Rüttinger (Plansee SE Innovation Services), O. Büchler, S. Uhlenbruck, N. Menzler (Forschungszentrum Jülich GmbH), A. Venskutonis, and L. Sigl (Plansee SE Innovation Services)
15:20	749	Development of Highly Robust, Volume-Manufacturable Metal-Supported SOFCs for Operation below 600℃ R. T. Leah, A. Bone, A. Selcuk, D. Corcoran, M. Lankin, Z. Dehaney-Steven, and P. Whalen (Ceres Power Technology Centre)
15:40		Intermission (20 Minutes)
16:00	750	Development of Long-Term Stable and High-Performing Metal-Supported SOFCs T. Klemensø, J. Nielsen, P. Blennow, A. Persson, T. Stegk, P. Hjalmarsson (Technical University of Denmark), B. Christensen, S. Sønderby (Danish Technological Institute), J. Hjelm, and S. Ramousse (Technical University of Denmark)
16:20	751	Metal Supported Solid Oxide Fuel Cell by Freeze Tape Casting P. Wei (McMaster University), S. Sofie (Montana State University), Q. Zhang (Exova), and A. Petric (McMaster University)
16:40	752	NexTech's FlexCell Technology for Planar SOFC Stacks M. Day, S. L. Swartz, and G. Arkenberg (NexTech Materials, Ltd.)
17:00	753	2R-Cell: A Universal Cell for an Easy and Safe SOFC Operation R. Ihringer (Fiaxell Sàrl)
17:20	754	Development of an All Ceramic SOFC I. Wærnhus, A. Vik, C. Ilea, and S. Faaland (CMR Prototech)

Room 516C, Level 5

SOFC Cathode Materials II

Co-Chairs: Tatsumi Ishihara and Kevin Kendall

Time	Progr#	Title and Authors
14:00	755	Towards a Fundamental Understanding of the Oxygen Reduction Mechanism E. D. Wachsman (University of Maryland)
14:20	756	Performance Analysis and Development Strategies for Solid Oxide Fuel Cells E. Ivers-Tiffée, J. Hayd, D. Klotz, A. Leonide, and A. Weber (Karlsruher Institut für Technologie)
14:40	757	Surface Cation Segregation and its Effect on the Oxygen Reduction Reaction on Mixed Conducting Electrodes Investigated by ToF-SIMS and ICP-OES M. Kubicek, A. Limbeck, G. Rupp, H. Hutter, and J. Fleig (Vienna University of Technology)
15:00	758	On the Thermodynamic Stability and the Kinetic Activity of SOFC Materials X. Zhou (University of South Carolina)
15:20	759	Viable AC Two-Probe Impedance Spectroscopy Based on Spatially-Limited Contact Probe for SOFC Cathode J. Lee, H. Ji, H. Kim, J. Son (Korea Institute of Science and Technology), and J. Hwang (Hongik University)
15:40		Intermission (20 Minutes)
16:00	760	Multi-Scale Assessment of Cr-Contamination Levels in SOFC Cathode Environment J. Schuler (Ecole Polytechnique Fédérale de Lausanne), A. Schuler (Paul Scherrer Institut), Z. Wuillemin, A. Hessler-Wyser (Ecole Polytechnique Fédérale de Lausanne), C. Ludwig (Paul Scherrer Institut), and J. Van Herle (Ecole Polytechnique Fédérale de Lausanne)
16:20	761	Degradation of Solid Oxide Fuel Cell Performance by Cr-Poisoning M. Kornely (Karlsruher Institut für Technologie), A. Neumann, N. Menzler (Forschungszentrum Jülich GmbH), A. Leonide, A. Weber, and E. Ivers-Tiffée (Karlsruher Institut für Technologie)
16:40	762	In-Situ Investigations of the Chromium Induced Degradation of the Oxygen Exchange Kinetics of the IT-SOFC Cathode Materials LSC and LSCF E. Bucher, M. Yang, and W. Sitte (University of Leoben)
17:00	763	Is Chromium Poisoning of LSM Cathodes Avoidable L. De Haart, A. Neumann, N. Menzler, and I. Vinke (Forschungszentrum Jülich GmbH)
17:20	764	Impact of the Volatile Cr-Species Attack on the Conductivity of $La(Ni,Fe)O_3$ M. K. Stodolny (Energy Research Centre of the Netherlands), B. Boukamp (University of Twente), and F. Van Berkel (Energy Research Centre of the Netherlands)

Room 517A, Level 5

SOFC Poster II (Electrolyte and Anode)

Co-Chairs: Srikanth Gopalan and Lincoln Miara

Time	Progr#	Title and Authors
o	765	Influence of Small Amounts of NiO on the Electrical Conductivity of 8YSZ R. Batista and E. N. Muccillo (Energy and Nuclear Research Institute)
o	767	Phase Transformation of Stabilized Zirconia on SOFC Stacks H. Kishimoto, T. Shimonosono, K. Yamaji, M. E. Brito, T. Horita, and H. Yokokawa (National Institute of Advanced Industrial Science and Technology)
o	768	Defect Formation in SOFC Electrolyte Films during Fabrication X. Wang and A. Atkinson (Imperial College London)
o	770	Characterization of Zirconia-India Ceramics Sintered by Spark Plasma D. Z. De Florio (Universidade Federal do ABC) and F. Coral Fonseca (Instituto de Pesquisas Energéticas e Nucleares São Paulo)
o	771	Self-Supported Thin Yttria-Stabilized Zirconia Electrolytes for Solid Oxide Fuel Cells Prepared by Laser Machining A. Larrea, D. Sola, M. Laguna-Bercero, J. Peña, R. Merino, and V. Orera (Instituto de Ciencia de Materiales de Aragón)
o	772	ZrO_2-CeO_2 Interface Properties: A First-Principle Investigation M. Fronzi (National Institute for Material Science), A. De Vita (Dipartimento dei Materiali e delle Risorse Naturali), Y. Tateyama, and E. Traversa (National Institute for Materials Science)
o	773	A Study of Coarsening Samarium Doped Ceria on Interaction with Yttria Stabilized Zirconia X. Zhang, P. Hamel, S. Yick, and M. Robertson (National Research Council Canada)
o	775	Thickness Effects of Yttria-Doped-Ceria Interlayers on Solid Oxide Fuel Cells Z. Fan and F. B. Prinz (Stanford University)
o	777	Electrical Properties of Tb and Sm Co-Doped Ceria Electrolyte at Different Oxygen Partial Pressures M. Vestli, G. Nurk, and E. Lust (University of Tartu)
o	778	The Influence of Sintering Time of Feedstock Powders on the Electrical Properties of $La_{10}(SiO_4)_6O_3$ Electrolyte Coatings W. Gao (Jilin University), H. Liao, and C. Coddet (University of Technology of Belfort-Montbéliard)
o	779	Soft Chemistry Routes for the Synthesis of $Sr_{0.02}La_{0.98}Nb_{0.6}Ta_{0.4}O_4$ Proton Conductor A. Santibáñez-Mendieta (University of Rome Tor Vergata), E. Fabbri (National Institute for Materials Science), S. Licoccia (University of Roma Tor Vergata), and E. Traversa (National Institute for Materials Science)
o	780	$BaCe_{0.8}Zr_{0.1}Y_{0.1}O_3$ Thin Film Deposited by Reactive Magnetron Sputtering M. Arab Pour Yazdi, P. Briois, and A. Billard (Université de Technologie de Belfort-Montbéliard)
o	781	Synthesis and Properties of $BaZr_{0.1}Ce_{0.7}Y_{02-x}M_xO_{3-\delta}$ (x = 0, 0.1, 0.2; M = Dy, Yb) Ion Conductors R. Muccillo and E. N. Muccillo (Energy and Nuclear Research Institute)
o	782	Durability Performance of $Ba(Zr_{0.1}Ce_{0.7}Y_{0.2})O_{3-\delta}$ as Proton Conducting Electrolyte for Intermediate Temperature SOFCs S. Min, Y. Jeon (Yonsei University), K. Ryu (LTC Inc.), and Y. Shul (Yonsei University)
o	783	Synthesis, Structure, and Electrical Transport Properties of $Ba_2(Ca_{0.67+x+y}Fe_xNb_y)(Nb_{1.33-y-z}Fe_z)O_{6-\delta}$ W. H. Kan, T. Trinh, T. Fürstenhaupt, and V. Thangadurai (University of Calgary)
o	784	A Novel High Conductivity Mixed Proton and Carbonate-Ion Conductor (MPCC) X. Li, L. Zhang, and K. Huang (University of South Carolina)
o	785	Apatite Coatings Deposited by DC Magnetron Sputtering P. Briois (Université de Technologie de Belfort-Montbéliard), S. Fourcade, F. Mauvy, J. Grenier (Université de Bordeaux), and A. Billard (Université de Technologie de Belfort-Montbéliard)
o	786	Influence of Additive Oxides on Electrochemical Performance of Y-Doped $SrTiO_3$ Anode in SOFCs P. Puengjinda, H. Muroyama, T. Matsui, and K. Eguchi (Kyoto University)
o	787	Catalytic Activities and Electrochemical Properties of Y and Fe Co-Doped $SrTiO_3$-Based Composite Anodes for Solid Oxide Fuel Cells (SOFCs) S. Yoon, Y. Kim, H. Hwang (Inha University), M. Ji, and B. Choi (Korea Institute of Ceramic Engineering and Technology)
o	788	Ceramic Oxide Anode with Precipitated Catalytic Nanoparticles for Ethanol Fueled SOFC N. Monteiro, S. Nóbrega, and F. C. Fonseca (IPEN-CNEN)
o	789	Electrochemical Performance of $(La,Sr)(Cr,Mn)O_3$-$(Ce,Gd)O_2$ Composite Oxide Anode for SOFC J. Lee (Korea Institute of Science and Technology), J. Lee (Korea University), H. Kim, H. Lee, and J. Lee (Korea Institute of Science and Technology)
o	790	Ab Initio Study of Activity and Coke-Tolerance of Ni/$CeZrO_2$ Anodes of SOFC as a Function of Zirconia Concentration M. Shishkin and T. Ziegler (University of Calgary)

- 791 Kinetic Modeling of Nickel Oxidation in SOFC Anodes J. Neidhardt, M. Henke, and W. G. Bessler (German Aerospace Center)
- 792 Evaluation of Porous x vol% Ni-YSZ Cermets with a Ni Content of 0 {less than or equal to} x {less than or equal to} 30 as Insulating Substrates for SOFCs M. Mori, Z. Wang (Central Research Institute of Electric Power Industry), and T. Itoh (AGC Seimi Chemical Co. Ltd.)
- 793 Influence of Anode Thickness on Cell Performance in Internal Reforming Operation of SOFCs Y. Lee, H. Sumi, H. Muroyama, T. Matsui, and K. Eguchi (Kyoto University)
- 794 Degradation Mechanism of Nickel-Yttria Stabilized Zirconia SOFC Anode Materials in PH_3 Containing Coal Syngas M. Zhi (US Department of Energy), J. Yan (West Virginia University), A. Manivannan (U.S. Department of Energy), and N. Wu (US Department of Energy)
- 795 Mesoporous NiO-CGO Obtained by Hard Template as High Surface Area Anode for IT-SOFC L. Almar, T. Andreu, A. Morata, and A. Tarancón (Catalonia Institute for Energy Research)
- 796 Determination of Three Dimensional Microstructure Parameters from a Solid Oxide Ni/YSZ Electrode P. S. Jørgensen and J. R. Bowen (Technical University of Denmark)
- 797 Theoretical Study for the Sintering of Nickel Anode in Solid Oxide Fuel Cell K. Nakao, T. Ogura, T. Ishimoto, and M. Koyama (Kyushu University)
- 798 Electrochemical Oxidation at SOFC Anodes: Comparison of Patterned Ni Anodes and Technical Ni/8YSZ Cermet Anodes A. Utz, J. Joos, A. Weber, and E. Ivers-Tiffée (Karlsruher Institut für Technologie)
- 799 Investigation of MgO Promoted NiO: SDC Anode Material for Intermediate Temperatures Solid Oxide Fuel Cells M. Phongaksorn, A. Yan, M. Ismail, A. Ideris, E. Croiset, S. Corbin (University of Waterloo), and Y. Yoo (National Research Council Canada)
- 800 Synthesis and Characteristics of Nano-ceria Supported Bimetallic Catalysts For S-tolerant SOFCs J. Bozeman, A. Marruffo, I. Barney, A. Jackson, S. Mukhopadhyay, and H. Huang (Wright State University)
- 801 Reverse Cell Bias for the Prevention of Ni Oxidation during Air Exposure J. L. Young, V. Vedharathinam, and V. I. Birss (University of Calgary)
- 802 Reaction Sites of Mixed Conductor Anodes in Solid Oxide Fuel Cells R. Kikuchi, T. Okamoto, K. Akamatsu, T. Sugawara, and S. Nakao (The University of Tokyo)
- 803 Sulfur Poisoning of SOFCs:Dependence on Operational Parameters T. Yoshizumi, C. Uryu, T. Oshima, Y. Shiratori, K. Ito, and K. Sasaki (Kyushu University)
- 805 Electrochemical Performance and H_2S Poisoning Study of Mo-Doped Ceria (CMO) SOFC Anodes B. Mirfakhraei, V. I. Birss, V. Thangadurai, S. Paulson (University of Calgary), K. E. Béré, and F. Gitzhofer (Université de Sherbrooke)
- 806 Effect of Porosity Gradient on Planar Anode-Supported SOFC at Utilization Hydrocarbon Fuel C. An (Colorado School of Mines), T. Yamaguchi (National Institute of Advanced Industrial Science and Technology), and N. Sammes (Colorado School of Mines)
- 807 Study on Degradation of Solid Oxide Fuel Cell with Pure Ni Anode Z. Jiao, N. Shikazono, and N. Kasagie (The University of Tokyo)
- 808 Elementary Kinetic Numerical Simulation of Electrochemical CO Oxidation on Ni/YSZ Pattern Anodes V. Yurkiv (Heidelberg University), A. Utz, A. Weber, E. Ivers-Tiffée (Karlsruher Institut für Technologie), H. Volpp (Heidelberg University), and W. G. Bessler (German Aerospace Center)
- 810 Fuel Flexible Anode for Solid Oxide Fuel Cells: An Electrochemical and Catalytic Study M. Lo Faro, A. Stassi, G. Monforte, M. Minutoli, V. Antonucci, and A. Aricò (CNR-ITAE)
- 811 Key Issues in Processing Metal-Supported Proton Conducting Anodes for SOFCs Applications E. Mercadelli, A. Gondolini, P. Pinasco, A. Sanson (ISTEC-CNR), S. Barison, and M. Fabrizio (IENI-CNR)
- 813 Optimization of Solid Oxide Fuel Cell Ni - GDC Anode Porosity K. Tamm, I. Kivi, G. Nurk, E. Anderson, P. Möller, M. Vestli, R. Kanarbik, and E. Lust (University of Tartu)
- 814 Fabrication of Direct Oxidation Solid Oxide Fuel Cell Anodes Using a Novel Technique in Atmospheric Plasma Spraying M. Cuglietta and O. Kesler (University of Toronto)
- 815 Particle Based Modeling of SOFC Anodes Using Experimentally Determined Particle Distributions and Structures V. L. Thomas (California Institute of Technology)
- 816 Perovskite-Based Anodes in Tubular Solid-Oxide Fuel Cells S. Babiniec, A. E. Richards, N. Faino, and N. Sullivan (Colorado School of Mines)
- 817 Analysis of Microscopic Anode Structure Effects on an Anode-Supported SOFC Including Knudsen Diffusion M. Andersson (Lund University), X. Lu (Dalian Maritime University), J. Yuan, and B. Sundén (Lund University)
- 818 Performances of Metal Particle-Dispersed Ceria Hydrogen Electrodes in Reversible SOFCs H. Uchida, R. Nishida, M. Tatsuzawa, H. Nishino, K. Kakinuma, and M. Watanabe (University of Yamanashi)
- 819 Enhanced Performances of $Ln_2NiO_{4+\delta}$ / CGO Multilayered Anodes for High Temperature Steam Electrolysis (HTSE) T. Ogier, F. Chauveau, J. Bassat, F. Mauvy, J. Grenier (Université de Bordeaux), J. Mougin, and M. Petitjean (Commissariat à l'Energie Atomique)

- o 820 Liquid Tin Anode SOFC for Direct Fuel Conversion - Cell, Stack and System Development T. Tao, M. Koslowske, and J. M. Bentley (CellTech Power)
- o 821 Numerical Modeling of Nickel-Impregnated Porous YSZ-Supported Anodes and with Comparison to Conventional Composite Ni-YSZ Electrodes E. Hardjo, D. S. Monder, and K. Karan (Queen's-RMC Fuel Cell Research Centre)
- o 822 Preparation and Structure of High Performance Anodes for Solid Oxide Fuel Cells X. Meng (Shanghai Jiao Tong University), N. Yang, B. Meng, X. Tan (Shandong University of Technology), Z. Ma, and Y. Yin (Shanghai Jiao Tong University)
- o 823 Effect of $Sm_{0.2}Ce_{0.8}O_{1.9}$ Modification for Direct Electrochemical Oxidation of Methane in Ni-based Anode of Solid Oxide Fuel Cell J. Yun, S. Yoon, J. Han, S. Park, H. Kim, and S. Nam (Korea Institute of Science and Technology)
- o 824 Experimental Study of the Ohmic Resistance between the Interconnect and the Ni-CGO Cermet C. Magnière (CEA Grenoble), B. Morel, and S. Di Iorio (Commissariat à l'Energie Atomique)

Wednesday, May 4, 2011

Room 517A, Level 5

Cell Design, Testing and Performance II

Co-Chairs: John Irvine and Anil Virkar

Time	Progr#	Title and Authors
08:00	825	Improved Redox-Cycling Resistant Tubular Ceramic Fuel Cells A. R. Hanifi, A. Torabi, M. Zazulak, T. H. Etsell (University of Alberta), and P. Sarkar (Alberta Innovates - Technology Futures)
08:20	826	Transient Performance of Micro-Tubular Solid Oxide Fuel Cells K. Howe and K. Kendall (University of Birmingham)
08:40	827	Performance and Energy Efficiency of a Single Microtubular Anode Supported Cell T. Suzuki, K. Hamamoto, T. Yamaguchi, F. Fujishiro (National Institute of Advanced Industrial Science and Technology), and S. Sugihara (Mazda Motor Corporation)
09:00	828	Evaluation of ScSZ-Based Microtubular SOFCs under 3% Humidified CH_4 Fuel Flow at Intermediate Temperature T. Yamaguchi, T. Suzuki (National Institute of Advanced Industrial Science and Technology), and N. Sammes (Colorado School of Mines)
09:20	829	Improvement of Fabrication Process and Performance of Cathode Supported Tubular Solid Oxide Fuel Cells J. Zhou, C. Zhao, X. Ye, S. Wang, and T. Wen (Chinese Academy of Sciences)
09:40		Intermission (20 Minutes)
10:00	830	Tubular Metal Support Solid Oxide Fuel Cell Manufacturing and Characterization L. M. Rodriguez-Martinez, M. Rivas, L. Otaegi, N. Gomez, M. Alvarez, E. Sarasketa-Zabala, J. Manzanedo (Ikerlan), N. Burgos, F. Castro (CEIT), A. Laresgoiti, and I. Villarreal (Ikerlan)
10:20	831	IP-SOFC Performance Measurement and Prediction B. Haberman, C. Martinez Baca, and T. Ohrn (Rolls-Royce Fuel Cell Systems)
10:40	832	Ultra-Low Mass SOFC Design M. Badding, W. Bouton, J. Brown, L. Kester, C. W. Tanner, and P. Tepesch (Corning Incorporated)
11:00	833	Thin Film Low Temperature Solid Oxide Fuel Cell (LTSOFC) by Reactive Spray Deposition Technology (RSDT) R. Maric (University of Connecticut), K. Furusaki, D. Nishijima (NGK Spark Plug Co., Ltd.), and R. Neagu (NRC Institute for Fuel Cell Innovation)
11:20	834	Low Temperature DMFC with YSZ Electrolyte J. Komadina, Y. Kim, J. Park, T. M. Gür (Stanford University), S. Kang (Samsung Electronics), and F. B. Prinz (Stanford University)
11:40	835	Ceramic Proton Conducting Solid Oxide Fuel Cells (H-SOFCs): Materials and Challenges V. Thangadurai, W. H. Kan, B. Mirfakhraei, S. Bhella, and T. Trinh (University of Calgary)

Room 516C, Level 5

SOFC Cathode Materials III

Co-Chairs: Brian Borglum and Kazunari Sasaki

Time	Progr#	Title and Authors
08:00	836	Nano-Particle Coarsening Effects in LSCF-Infiltrated Cathodes M. Shah, A. Call, G. Hughes, P. W. Voorhees, and S. A. Barnett (Northwestern University)
08:20	837	Microstructural Aspects on the Performance of LSCF Cathodes for SOFCs R. Costa, Z. Ilhan, and A. Ansar (German Aerospace Center)
08:40	838	Microstructural Effects on the Oxygen Exchange Kinetics of $La_{0.7}Sr_{0.3}MnO_3$ Thin Films L. Yan and P. Salvador (Carnegie Mellon University)
09:00	839	The Structural Disorder and Lattice Stability of BSCF Complex Perovskites M. M. Kuklja (University of

Maryland), Y. Mastrikov (University of Latvia), S. Rashkeev (Idaho National Laboratory), and E. Kotomin (Max Planck Institute for Solid State Research)

09:20	840	Systematic Studies of the Cathode-Electrolyte Interface in SOFC Cathodes Prepared by Infiltration R. Küngas, J. Vohs, and R. Gorte (The University of Pennsylvania)
09:40		Intermission (20 Minutes)
10:00	841	Strain Effects on the Surface Chemistry and Electronic Structure of $La_{0.7}Sr_{0.3}MnO_3$ H. Jalili, J. Han, Y. Kuru, Z. Cai, and B. Yildiz (Massachusetts Institute of Technology)
10:20	842	The Effects of Stress on the Defects and Electronic Properties of Mixed Ionic Electronic Conductors O. Comets and P. W. Voorhees (Northwestern University)
10:40	843	Strain Effects on Defect Chemistry in Epitaxial Perovskite Thin Films for Solid Oxide Fuel Cells M. Gadre, Y. Lee, N. Swaminathan, and D. Morgan (University of Wisconsin-Madison)
11:00	844	Mechanistic Interpretation of the Oxygen Reduction Kinetics of $La_{0.85}Sr_{0.15}MnO_3$ Cathode L. Miara, U. Pal, and S. Gopalan (Boston University)
11:20	845	A New Model Describing Cathode Kinetics in SOFC: Model Thin Film $SrTi_{1-x}Fe_xO_{3-\delta}$ Mixed Conducting Oxides - A Case Study W. Jung (California Institute of Technology) and H. L. Tuller (Massachusetts Institute of Technology)
11:40	846	$Ln(Sr,Ca)_3(Fe,Co)_3O_{10}$ Intergrowth Oxide Cathodes for Solid Oxide Fuel Cells A. Manthiram, Y. Kim, and J. Kim (The University of Texas)

Room 517A, Level 5

Cell Design, Testing and Performance III

Co-Chairs: Alan Atkinson and Anthony Petric

Time	Progr#	Title and Authors
14:00	847	Imaging of Oxide Ionic Flow at Practical SOFC Cells by Isotope Labeling Technique T. Horita, T. Shimonosono, H. Kishimoto, K. Yamaji, M. E. Brito, H. Yokokawa (National Institute of Advanced Industrial Science and Technology), and Y. Hori (Kyocera Corporation)
14:20	848	The Influence of Porous Support Morphology on the Electrochemical Performance of Solid Oxide Fuel Cells A. Torabi, A. R. Hanifi, T. H. Etsell (University of Alberta), and P. Sarkar (Alberta Innovates - Technology Futures)
14:40	849	Accelerated Degradation by Impurities for Evaluating Life Time of SOFCs T. Horita, H. Kishimoto, K. Yamaji, M. E. Brito, T. Shimonosono, D. Cho, M. Izuki, F. Wang, and H. Yokokawa (National Institute of Advanced Industrial Science and Technology)
15:00	850	Evaluation of Stress Conditions in Operated Anode Supported Type Cells Based on In-Situ Raman Scattering Spectroscopy F. Iguchi, M. Nagai, S. Onodera, N. Sata, T. Kawada, and H. Yugami (Tohoku University)
15:20	851	Anode/Electrolyte Interface Modification in LSGM Electrolyte Supported SOFC K. Kawahara, S. Suda, M. Suzuki (Japan Fine Ceramics Center), M. Kawano, H. Yoshida (The Kansai Electric Co., Inc.), and T. Inagaki (The Kansai Electric Power Co., Inc.)
15:40		Intermission (20 Minutes)
16:00	852	Study of Flow Rate and Temperature Variations in a Segmented SOFC C. Willich, G. Schiller (German Aerospace Center), U. Maier (ElringKlinger AG), and K. Friedrich (German Aerospace Center)
16:20	853	Fractal Current Collection Structures for Thin Electrolyte Supported Fuel Cells C. W. Tanner and K. L. Work (Corning Incorporated)
16:40	854	Ceramic Microchannel Reactor for SOFC Applications D. M. Murphy, N. Sullivan, R. J. Kee, M. Hartmann, and N. E. McGuire (Colorado School of Mines)
17:00	855	Characterization of Propane-Fueled SOFC Stacks and a Portable Power System Y. Du, D. Cui, and K. Reifsnider (University of South Carolina)

Room 516C, Level 5

SOFC Anode Materials I

Co-Chairs: Scott Barnett and Ming-Fang Han

Time	Progr#	Title and Authors
14:00	856	Single Step Preparation of Nano-Dispersed NiO/YSZ Composites for Solid Oxide Fuel Cell J. Song, Y. Park, H. Bae, J. Ahn, B. Seong, D. Kim, and J. Jun (Research Institute of Industrial Science and Technology)
14:20	857	Multilayered SOFC Anode Structure with Electroless Ni-YSZ for Enhancement of Cell Performance M. Mukhopadhyay, J. Mukhopadhyay, A. Das Sharma, and R. N. Basu (Central Glass and Ceramic Research Institute)
14:40	858	Influence of Tertiary Phases Incorporated into Ni-based Cermets by Solution Precursor Plasma Spraying (SPPS) on Anode Stability E. Lay, C. Metcalfe, and O. Kesler (University of Toronto)

15:00 859 3D Imaging of Nickel Oxidation States Using Full Field X-ray Absorption near Edge Structure Spectroscopy W. Harris, G. Nelson, J. Izzo (University of Connecticut), K. N. Grew (U.S. Army Research Laboratory), W. K. Chiu (University of Connecticut), Y. Chu (Brookhaven National Laboratory), J. Andrews, Y. Liu, P. Pianetta (Stanford Linear Accelerator Center), and J. Yi (Argonne National Laboratory)

15:20 860 X-ray Imaging and Analysis of 3D Microstructural Changes in Aged Ni-YSZ Anodes G. Nelson, J. Izzo, J. Lombardo, W. Harris, A. Cocco, W. K. Chiu (University of Connecticut), K. N. Grew (U.S. Army Research Laboratory), A. Faes, A. Hessler-Wyser, J. Van Herle (Ecole Polytechnique Fédérale de Lausanne), Y. Chu (Brookhaven National Laboratory), and S. Wang (Argonne National Laboratory)

15:40 Intermission (20 Minutes)

16:00 861 Characterization and Carbon Tolerance of New Au - Mo - Ni/GDC Cermet Powders for Use as Anode Materials in Methane Fuelled SOFCs D. K. Niakolas, M. Athanasiou, S. Neophytides, and S. Bebelis (Foundation for Research and Technology)

16:20 862 Study of Ga Doped LSCM as an Anode for SOFC A. Ghosh, A. Azad, and J. T. Irvine (University of St Andrews)

16:40 863 Preliminary Studies of the Ba-Doped La/Sr Chromo-Manganite Series as New SOFC Anode Materials E. Lay (University of Toronto), G. Gauthier (CEA), and L. Dessemond (Grenoble INP)

17:00 864 A Novel Redox Stable Catalytically Active Electrode for Solid Oxide Fuel Cells Q. Liu, G. Xiao (University of South Carolina), T. Howell, T. L. Reitz (Air Force Research Laboratory), and F. Chen (University of South Carolina)

Thursday, May 5, 2011

Room 517A, Level 5

SOFC Alternate Fuels I

Co-Chairs: Joongmyeon Bae and Steven McIntosh

Time Progr# Title and Authors

08:00 865 Application of Biofuels to Solid Oxide Fuel Cell Y. Shiratori, T. Tran, Y. Takahashi, and K. Sasaki (Kyushu University)

08:20 866 Biogas Fuel Reforming for Solid Oxide Fuel Cells D. M. Murphy, A. E. Richards, A. M. Colclasure, W. Rosensteel, and N. Sullivan (Colorado School of Mines)

08:40 867 SOFC Power Generation from Biogas - Maximize the System Efficiency with Combined Dry-/Steam Reforming R. Dietrich, A. Lindermeir, J. Oelze (CUTEC-Institut GmbH), C. Spieker, C. Spitta, and M. Steffen (Zentrum für BrennstoffzellenTechnik GmbH)

09:00 868 Biomass Conversion in a Fluidized Bed Direct Carbon Fuel Cell B. R. Alexander, R. Mitchell, and T. M. Gür (Stanford University)

09:20 869 Sorbents for BioFueled SOFCs G. Alptekin, A. Jayaraman, and M. Schaefer (TDA Research Inc)

09:40 Intermission (20 Minutes)

10:00 870 Influence of Operation Conditions on the Carbon Deposition of SOFC Fuelled by Gasified-Syngas with Tar Included M. Liu (Delft University of Technology), M. Millan (Imperial College London), P. Aravind (Delft University of Technology), and N. Brandon (Imperial College London)

10:20 871 Transient Operation Effects of SOFCs Driven with Tar Loaded Synthesis Gas M. Hauth and J. Karl (Graz University of Technology)

10:40 872 Liquid Tin-Lead Anode Solid Oxide Fuel Cell Fueled by Coal M. LaBarbera, M. Fedkin, and S. Lvov (The Pennsylvania State University)

11:00 873 Startup Characteristics of Propane-Fueled Solid Oxide Fuel Cell Hot Zones Y. Du, D. Cui, K. Reifsnider, and F. Chen (University of South Carolina)

11:20 874 An Electrochemical Model of Anode Supported Microtubular SOFCs Powered by Ammonia J. Huo and X. Zhou (University of South Carolina)

11:40 875 Direct-DME SOFC for Intermediate Operation Temperature Using Proton Conductor as the Electrolyte K. Takeuchi, R. Tai (Tokyo University of Science), K. Ui (Iwate University), K. Fujimoto, S. Ito (Tokyo University of Science), H. Koyanaka (Kyoto University), and N. Koura (Tokyo University of Science)

Room 516C, Level 5

SOFC Anode Materials II

Co-Chairs: Anke Hagen and Junichiro Mizusaki

Time Progr# Title and Authors

08:00 876 Microstructural Characterization of SOFC Electrodes: Observations and Simulations P. Shearing, Q. Cai, C. Adjiman, A. Marquis, R. Clague (Imperial College London), J. Gelb (Xradia Inc), R. Bradley, P. Withers (University of Manchester), and N. Brandon (Imperial College London)

08:20 877 Correlation between Microstructure and Electrochemical Characteristics of Ni-YSZ Anode Subjected to

Redox Cycles H. Muroyama, H. Sumi, R. Kishida, J. Kim, T. Matsui, and K. Eguchi (Kyoto University)

08:40 878 Microwave-Assisted Preparation of Cu Coated Ni/YSZ Anode for Direct Utilization of Dry CH_4 in SOFC S. Islam and J. M. Hill (University of Calgary)

09:00 879 Evaluation of Sn-Doped Ni/YSZ SOFC Anodes for the Direct Utilization of Methane A. Singh and J. M. Hill (University of Calgary)

09:20 880 In-Situ Measurement of SOFC Anode Surface Processes E. J. Brightman, R. Maher, and N. Brandon (Imperial College London)

09:40 Intermission (20 Minutes)

10:00 881 Impedance Studies on Solid Oxide Fuel Cells with Yttrium-Substituted $SrTiO_3$ Ceramic Anodes Q. Ma, F. Tietz (Forschungszentrum Jülich GmbH), A. Leonide, and E. Ivers-Tiffée (Karlsruher Institut für Technologie)

10:20 882 Evaluating Overpotentials in GDC Electrodes for H_2/H_2O Reactions in Solid Oxide Electrochemical Cells L. Wang, C. Zhang (University of Maryland), M. Grass (Lawrence Berkeley National Laboratory), K. Gaskell (University of Maryland), Z. Hussain, Z. Liu (Lawrence Berkeley National Laboratory), B. Eichhorn, and G. Jackson (University of Maryland)

10:40 883 Understanding Performance Losses at Ni-Based Anodes Due to Sulfur Exposure V. I. Birss, S. Paulson, and T. Smith (University of Calgary)

11:00 884 Mg and Fe Modified Ni/GDC Cermets as Sulfur-Tolerant Anodes of Solid Oxide Fuel Cells S. Jiang and L. Zhang (Curtin University)

11:20 885 Characterization of the Ni-8YSZ Cermet Creep and Its Impact on the Cell 'Redox' Tolerance J. Laurencin, G. Delette, F. Usseglio-viretta (CEA), S. Di Iorio (Commissariat à l'Energie Atomique), and F. Lefebvre (CEA)

11:40 886 Effect of Redox Cycling on Mechanical Properties of Ni-YSZ Cermets for SOFC Anodes S. Sukino, S. Watanabe, K. Sato, T. Kawada, J. Mizusaki, and T. Hashida (Tohoku University)

Room 517A, Level 5

SOFC Alternate Fuels II

Co-Chairs: Mogens Mogensen and Turgut Gur

Time Progr# Title and Authors

14:00 887 The Role of Surface Carbon in Catalytic and Electrocatalytic Oxidation of Ethylene and Toluene on Pt-ceria Anodes for Solid Oxide Fuel Cells V. Medvedev and E. M. Stuve (University of Washington)

14:20 888 Design and Testing of Structured Catalysts for Internal Reforming of CH_4 in Intermediate Temperature Solid Oxide Fuel Cells (IT SOFC) Cells A. Smirnova (Eastern Connecticut State University), V. Sadykov, N. Mezentseva, R. Binina, V. V. Pilipenko, G. Alikina, L. N. Bobrova (Boreskov Institute of Catalysis), O. L. Smorygo (Powder Metallurgy Institute), F. Van Berkel (Energy Research Centre of the Netherlands), and B. Rietveld (Energy Research Center of the Netherlands)

14:40 889 Towards Understanding the Hydrocarbon Oxidation Activity of Oxides for Direct Hydrocarbon SOFC Anodes S. McIntosh (Lehigh University) and M. Van den Bossche (University of Virginia)

15:00 890 In-Situ Optical Studies of Solid Oxide Fuel Cells Operating with Dry and Wet Oxygenated Fuels B. Eigenbrodt (University of Maryland), J. Kirtley, and R. A. Walker (Montana State University)

15:20 891 Effect of Hydrogen Sulfide on Electrochemical Oxidation of Syngas for SOFC Application M. Roushanafshar, J. Luo, K. Chuang, and A. Sanger (University of Alberta)

15:40 Intermission (20 Minutes)

16:00 892 Impurity Poisoning of SOFCs K. Sasaki, K. Haga, T. Yoshizumi, D. Minematsu, E. Yuki, R. Liu, C. Uryu, T. Oshima, S. Taniguchi, Y. Shiratori, and K. Ito (Kyushu University)

16:20 893 Analysis of Fuel Options for SOFC-Based Power Systems in Undersea Vehicles L. Carreiro and A. Burke (Naval Undersea Warfare Center)

16:40 894 Non-Thermal Plasma Reformation of Liquid Fuels S. Elangovan, J. Hartvigsen, M. Hollist, P. Czernichowski, and L. Frost (Ceramatec, Inc.)

17:00 895 Studies on Direct Ethanol Use in SOFCs J. T. Irvine and G. P. Corre (University of St Andrews)

17:20 896 Solid Oxide Fuel Cell Fueled by Diesel Reformate and Anaerobic Digester Gas M. LaBarbera, M. Fedkin, X. Wang, X. Chao, C. Song, and S. Lvov (The Pennsylvania State University)

Room 516C, Level 5

SOFC Anode Materials III

Co-Chairs: Josephine Hill and Ellen Ivers-Tiffee

Time Progr# Title and Authors

14:00 897 A Study of the Rheological Properties of NiO/ScSZ Screen-Printing Inks and Their Application to SOFC Anodes M. Somalu, N. Brandon, and V. Yufit (Imperial College London)

14:20 898 Measurement of Knudsen and Effective Fickian Diffusion Coefficients in Solid Oxide Fuel Cell Anodes Fabricated by Atmospheric Plasma Spraying Using Solution Precursor, Suspension, and Powder Feedstocks C. Metcalfe, E. Lay, and O. Kesler (University of Toronto)

14:40 899 Electrooxidation of Reformate Gases at Model Anodes A. Weber, A. Utz, J. Joos, E. Ivers-Tiffée, H. Störmer, D. Gerthsen (Karlsruher Institut für Technologie), V. Yurkiv, H. Volpp (Heidelberg University), and W. G. Bessler (German Aerospace Center)

15:00 900 Gas Transport and Internal Reforming Chemistry in SOFC Anode Supports and Structures A. E. Richards, N. Sullivan, R. J. Kee, M. McNeeley, and S. Babiniec (Colorado School of Mines)

15:20 901 Performance of $Sm_{0.95}Ce_{0.05}Fe_{1-x}Ni_xO_{3-\delta}$Perovskite as Anode Materials under Methane Fuel for Low Temperature Solid Oxide Fuel Cells (LT -SOFC) S. M. Bukhari and J. B. Giorgi (University of Ottawa)

15:40 Intermission (20 Minutes)

16:00 902 Adsorptive Properties of the $Ni_{1-X}Co_X$-Based Cermet Anode for the Oxidation of Methane T. Sawahata, H. Takayanagi, T. Wah Tzu, and K. Sato (Nagaoka University of Technology)

16:20 903 Gas Products Analysis during the Electrochemical Conversion of Dry Methane with a $La_{0.3}Sr_{0.7}TiO_3$ and Ni/YSZ Bi-Layer SOFC Anode M. A. Buccheri and J. M. Hill (University of Calgary)

16:40 904 Thermal Imaging of Solid Oxide Fuel Cell Anode Degradation with Dry and Wet Ethanol Fuel Flows M. B. Pomfret (United States Naval Research Laboratory), D. Steinhurst (Nova Research, Inc.), and J. Owrutsky (United States Naval Research Laboratory)

17:00 905 Determination of Safe Operating Conditions to prevent Ni-YSZ Anode Supported SOFC Damage V. Roche, C. Roux, and M. Steil (CNRS)

17:20 906 Impact of Ni on Accelerated Degradation of 8.5 Mol% Y_2O_3-Doped Zirconia A. Lefarth (Karlsruher Institut für Technologie), B. Butz (University of Erlangen-Nürnberg), H. Störmer, A. Utz, and D. Gerthsen (Karlsruher Institut für Technologie)

Room 517A, Level 5

SOFC Poster III (Cell and Stack Design, Performance and Modelling)

Co-Chairs: Yanhai Du and Subhash Singhal

Time	Progr#	Title and Authors
o	907	Novel Materials and Components for SOFCs S. Somov, A. Demin (Solid Cell Inc), D. Bronin, and F. Gulbis (Institute of High Temperature Electrochemistry, RAS)
o	908	Novel SOFCs with 1 Micrometer Thick 8YSZ Electrolyte Layers T. Van Gestel (Forschungszentrum Jülich)
o	909	Development of Planar Solid Oxide Fuel Cell in Niroo Research Institute, Iran H. Mohebbi, A. Raoufi, A. H. Ghobadzadeh, R. Mahmoodi, and H. Aslannejad (Niroo Research Institute)
o	910	Sol-Gel Process to Prepare an Anode Supported SOFC E. Courtin, P. Boy, K. Vallé (CEA/DAM Le Ripault), N. Poirot (LEMA, IUT de Blois), and C. Laberty-Robert (UPMC, Collège de France)
o	911	Fabrication of Solid Oxide Fuel Cell Using the Dual Tape Casting Method A. H. Ghobadzadeh, H. Mohebbi, M. Zhiani, N. Manafi Rasi, and M. Rezaee (Niroo Research Institute)
o	912	Fabrication and Development of Perovskite Anode Supported Planar SOFCs A. T. Tesfai, C. Savaniu, and J. T. Irvine (University of St Andrews)
o	913	SOFC Material and Stack Characterization Tests for Micro-CHP Application S. McPhail (ENEA), G. Cinti, G. Discepoli (University of Perugia), and A. Moreno (ENEA)
o	914	A New Type of SOFC for Conversion of High Temperature Heat to Electricity without Carnot Limitation K. T. Jacob (Indian Institute of Science)
o	915	Fundamental Thermodynamic Modifications in Wagner's Equation in Solid State Electrochemistry T. Miyashita (Miyashita Clinic)
o	916	Advanced Thermal Spray Processes and Material Development for Industrialization of SOFC Components M. Gindrat and H. Höhle (Sulzer Metco AG)
o	917	Progress toward Inkjet Deposition of Segmented-in-Series Solid-Oxide Fuel Cell Architectures N. Faino, B. Gorman, W. Rosensteel, and N. Sullivan (Colorado School of Mines)
o	918	Challenges of Thin Layers for SOFC Devices: From Low-Cost Chemical Bath Deposition (CBD) to Atomic Layer Deposition (ALD) B. Medina-Lott, M. Tassé, M. Benamira, A. Ringuedé (Chimie-ParisTech), L. Niinistö (Helsinki University of Technology), and M. Cassir (Chimie ParisTech)
o	920	Universal SOFC Module for Rapid Start-Ups U. Bossel (ALMUS AG)
o	921	High Efficiency CFY-Stack for High Power Applications S. Megel (Fraunhofer Institute of Ceramic Technologies and Systems), M. Kusnezoff, N. Trofimenko, V. Sauchuk (Fraunhofer Institute for Ceramic Technologies and Systems), A. Michaelis (Fraunhofer Institute of Ceramic Technologies and Systems), A. Venskutonis, W. Kraussler, M. Brandner, C. Bienert, and L. Sigl (Plansee SE Innovation Services)
o	922	The Effects of Dynamic Dispatch on the Degradation and Lifetime of Solid Oxide Fuel Cell Systems A. Nakajo (Ecole Polytechnique Fédérale de Lausanne), F. Muller, D. McLarty, J. Brouwer (University of

California, Irvine), J. Van Herle, and D. Favrat (Ecole Polytechnique Fédérale de Lausanne)

- o 923 Electrochemical Performance of Cone-Shaped Tubular Anode Supported Solid Oxide Fuel Cells Fabricated by Low-Pressure Injection Moulding Technique J. Xiao, J. Liu (South China University of Technology), and J. Ding (Zhongkai University of Agriculture and Engineering)
- o 924 Micro-Tubular Solid Oxide Fuel Cells under Redox Conditions C. M. Dikwal, W. Bujalski, G. Nahar, and K. Kenall (University of Birmingham)
- o 925 Performance of Anode Microstructure Controlled Ni-ScSZ/LSGM/LSCF-Ag SOFCs by Low Temperature Fabrication Process Y. Endo, K. Sasaki, A. Suzuki, and T. Terai (The University of Tokyo)
- o 926 Evaluation of Fuel Cell Performance and Degradation M. Williams, R. Gemmen, and G. Richards (U.S. Department of Energy)
- o 927 Impedance Analysis of Practical Segmented-in-Series Tubular Solid Oxide Fuel Cells B. Liu, T. Matsui, H. Muroyama (Kyoto University), K. Tomida (Mitsubishi Heavy Industry, Ltd.), T. Kabata (Mitsubishi Heavy Industries, Ltd), and K. Eguchi (Kyoto University)
- o 928 Impedance Behavior of SOFC at High Fuel Utilization and a Way of Evaluating Diffusion Contribution A. Momma, Y. Tanaka, K. Takano, and T. Kato (National Institute of Advanced Industrial Science and Technology)
- o 929 FIB-TEM y FIB-SEM Characterization of the Electrode/Electrolyte Interface in Solid Oxide Fuel Cell Materials A. L. Soldati, L. Baqué, H. Troiani, C. Cotaro (Centro Atómico Bariloche), A. Schreiber (Helmholtz-Zentrum Potsdam), R. Wirth (GFZ-Potsdam), A. Caneiro, and A. Serquis (Centro Atómico Bariloche)
- o 930 Hydrogen-Oxidation Kinetics in Reformate Fuelled Anode Supported SOFC A. Kromp (Karlsruher Institut für Technologie (KIT)), A. Leonide, A. Weber, and E. Ivers-Tiffée (Karlsruher Institut für Technologie)
- o 931 Operation of Tubular Segmented-In-Series Solid Oxide Fuel Cell (SOFC) Unit Bundle T. Lim, U. Yun, J. Lee, S. Lee, S. Park, R. Song, and D. Shin (Korea Institute of Energy Research)
- o 932 Metal-Supported SOFC with Ceramic-Based Anode P. Blennow, T. Klemensø, A. Persson, K. Brodersen, B. Sudireddy, X. Mao, and S. Ramousse (Technical University of Denmark)
- o 933 Fabrication of Direct Carbon Fuel Cell Based on a General Anode-Support Tubular Solid Oxide Fuel Cell (SOFC) T. Lim, M. Jo, J. Lee, S. Lee, S. Park, R. Song, and D. Shin (Korea Institute of Energy Research)
- o 934 Analytical Investigation of Cell Performance of Intermediate-Temperature Disk Type Seal-Less SOFC Fueled by Methane T. Tanaka (Ibaraki University), Y. Inui (University of Shiga Prefecture), and N. Chitose (Mitsubishi Materials Corporation)
- o 935 Anode-Supported Tubular SOFC at Low Temperature Using Ni-Fe-GDC as an Anode Support B. Liang, T. Suzuki, K. Hamamoto, T. Yamaguchi, Y. Fujishiro (National Institute of Advanced Industrial Science and Technology), B. Ingram, and J. Carter (Argonne National Laboratory)
- o 936 Power Generating Property of Tubular SOFC Using DME as a Fuel - Focus on Portable Device - K. Sato, Y. Tanaka, A. Momma, K. Kato, A. Negishi, and T. Kato (National Institute of Advanced Industrial Science and Technology)
- o 937 Investigation on the Electrochemical Properties of the Ni-YSZ/Ni-ScSZ/ScSZ/LSM Tubular Solid Oxide Electrolysis Cell for High Temperature Steam Electrolysis L. Shao, S. Wang, J. Qian, Y. Xue, and R. Liu (Chinese Academy of Sciences)
- o 938 Combined Theoretical and Experimental Studies of H2 and CO Oxidation over the YSZ Surface A. Gorski, V. Yurkiv (Heidelberg University), W. G. Bessler (German Aerospace Center), and H. Volpp (Heidelberg University)
- o 939 Numerical Simulation of Anode-Supported Disc-Type Single Cell at Anode Off-Gas Recycle Y. Tanaka, A. Momma, K. Sato, and T. Kato (National Institute of Advanced Industrial Science and Technology)
- o 940 Measurement and Prediction of Temperature Distribution in a SOFC Short Stack S. Celik, B. Timurkutluk, M. Mat, and Y. Kaplan (Nigde University)
- o 941 Environmental Effects on a Thermally Self-Sustained SOFC Hot Zone D. Cui, Y. Du, K. Reifsnider, and F. Chen (University of South Carolina)
- o 942 Comparison between FIB-SEM Experimental 3-D Reconstructions of SOFC Electrodes and Random Particle-Based Numerical Models H. Choi, D. Gawel, A. Berson, J. Pharoah, and K. Karan (Queen's-RMC Fuel Cell Research Centre)
- o 943 Exchange Current Density at SOFC Electrodes T. Yonekura, Y. Tachikawa, T. Yoshizumi, Y. Shiratori, K. Ito, and K. Sasaki (Kyushu University)
- o 944 Production of Current Collector Supported Micro-Tubular Solid Oxide Fuel Cells with Sacrificial Inner Core R. De La Torre, M. Casarin, and V. M. Sglavo (University of Trento)
- o 945 Investigations on Single Chamber Solid Oxide Fuel Cells: From Single Cell to Micro-Stack Z. Lü, B. Wei, M. Liu, Z. Wang, Y. Tian, and W. Su (Harbin Institute of Technology)
- o 946 The Performance of a Single-Chamber Solid Oxide Fuel Cell Operated under Thin Oxygen Condition within Methane Fuel Y. Liu, Z. Lü, and Y. Tian (Harbin Institute of Technology)
- o 947 Towards Understanding the Dual Membrane Fuel Cell (IDEAL-Cell) Using a Metallic Central Membrane Z.

Ilhan, A. Ansar, N. Wagner (German Aerospace Center), S. Presto, M. Viviani, A. Babucci (CNR), D. Vladikova, Z. Stoynov (Institute of Electrochemistry and Energy Systems), and A. Thorel (Mines-ParisTech)

- o 948 Modeling Elementary Components of Fuel Cells Using DFT: CeO_2M.Bulk, (111), (110) Surfaces Properties and Adsorption of Hydrogen T. Désaunay (Chimie ParisTech), A. Ringuedé (Chimie-ParisTech), M. Cassir, C. Adamo, and F. Labat (Chimie ParisTech)
- o 949 Performance Study and Sensitivity Analysis of Counter-Flow Planar Solid Oxide Fuel Cell by Three Dimensional Simulations Y. Mollayi Barzi, N. Manafi Rasi, A. Raoufi, and H. Kanani (Niroo Research Institute)
- o 950 Numerical Approach of a Single-Chamber Solid Oxide Fuel Cell without Mixed Reactant Feeding S. Ould Ahmedou, J. Deseure, O. Doche (CNRS Grenoble INP-UJF), and Y. Bultel (Université Joseph Fourier)
- o 951 Numerical Analysis on the Dynamic Behavior of a Solid Oxide Fuel Cell with a Multivariable Control Strategy Y. Komatsu, S. Kimijima (Shibaura Institute of Technology), and J. Szmyd (AGH - University of Science and Technology)
- o 952 High-Temperature CO_2 and H_2O Electrolysis with an Electrolyte-Supported Solid Oxide Cell Q. Fu, J. Dailly, A. Brisse, and M. Zahid (European Institute for Energy Research)
- o 953 Hydrogen Production by High Temperature Electrolysis Using Solid Oxide Electrolyzer Cells S. Kim, J. Yu, I. Han, D. Seo, K. Hong, and S. Woo (Korea Institute of Energy Research)
- o 954 Electrochemical Analysis of Biogas Fueled Anode Supported SOFC A. Leonide, A. Weber, and E. Ivers-Tiffée (Karlsruher Institut für Technologie)
- o 956 A Proposed Method for High Efficiency Electrical Energy Storage Using Solid Oxide Cells D. M. Bierschenk, J. R. Wilson, E. Miller, E. Dutton, and S. A. Barnett (Northwestern University)
- o 957 Development of Tubular Solid Oxide Electrolysis Stacks for Hydrogen Production T. Kato, K. Sato, T. Honda, A. Negishi, Y. Tanaka, A. Momma, K. Kato, and Y. Iimura (National Institute of Advanced Industrial Science and Technology)
- o 958 Novel Structured Micro-Tubular High Temperature Solid Oxide Electrolysis Cells C. Jin, C. Yang, and F. Chen (University of South Carolina)
- o 959 The Strategic Electrochemical Research Center in Denmark M. Mogensen and K. Hansen (The Technical University of Denmark)
- o 960 Low Temperature Operating Micro Solid Oxide Fuel Cells with Perovskite Type Proton Conductors F. Iguchi, K. Kubota, Y. Inagaki, S. Tanaka, N. Sata, M. Esashi, and H. Yugami (Tohoku University)
- o 961 Internal Methane Reforming High Temperature Proton Conductor (HTPC) Fuel Cells I. Luisetto, E. Di Bartolomeo, A. D'Epifanio, F. Basoli (University of Rome Tor Vergata), and S. Licoccia (University of Roma Tor Vergata)
- o 962 Performance of Solid Oxide Fuel Cells with In-Doped $BaZrO_3$ Electrolyte Films on Different Anode Substrates L. Bi, E. Fabbri, and E. Traversa (National Institute for Materials Science)
- o 963 Improving the Performance of Intermediate Temperature Solid Oxide Fuel Cells Based on $BaZrO_3$ Proton Conducting Electrolyte E. Fabbri, L. Bi, D. Pergolesi, and E. Traversa (National Institute for Materials Science)
- o 964 Chemically Stable Electrolytes and Advanced Electrode Architectures for Efficient Proton Ceramic Fuel Cells G. Taillades, P. Battochi, M. Taillades, D. Jones, and J. Roziére (Université Montpellier 2)
- o 965 Model-Based Evaluation of the Production of Pure Oxygen through SOFC/SOEC Integration M. A. Taher, C. Adjiman (Imperial College London), P. Iora (Universita` degli Studi di Brescia), P. Chiesa (Politecnico di Milano), and N. Brandon (Imperial College London)
- o 966 Self-Consistent-Field Electrochemistry D. Gatewood (U.S. Naval Research Laboratory), C. Turner (The University of Alabama), and B. I. Dunlap (U.S. Naval Research Laboratory)
- o 967 Numerical Simulation of Multi-Channel Planar Solid Oxide Fuel Cell Unit by Integrating Continuum Micro-Scale PEN Sub-Model H. Wang, Y. Shi, and N. Cai (Tsinghua University)
- o 968 Anode-Supported Micro-Tubular SOFC: Fabrication and Performance Analysis through Mathematical Modeling Y. Kim, J. Lee, T. Lim, S. Lee, S. Park, R. Song, and D. Shin (Korea Institute of Energy Research)
- o 971 Phase Field Model of Electrochemical Impedance for SOFC Electrode Studies W. Gathright and D. Lewis (Rensselaer Polytechnic Institute)
- o 972 Current Distribution Analysis of a Microtubular Solid Oxide Fuel Cell with Surface Temperature Measurements H. Nakajima and T. Kitahara (Kyushu University)
- o 973 Solid Oxide Fuel Cell Electrode 3D Microstructure and Performance Modelling K. Rhazaoui, Q. Cai, P. Shearing, C. Adjiman, and N. Brandon (Imperial College London)
- o 974 Effect of the Porous Micro-Structural Properties on the Performance with the Cell Model in Solid Oxide Fuel Cells H. Choi, A. Berson, J. Pharoah (Queen's-RMC Fuel Cell Research Centre), and S. Beale (National Research Council, Canada)

Friday, May 6, 2011

Room 517A, Level 5

SOFC Modelling I

Co-Chairs: Wilson Chiu and Robert Kee

Time	Progr#	Title and Authors
08:00	975	Modeling SOFC Cathodes Based on 3-D Representations of Electrode Microstructure C. Kreller, M. Drake, and S. B. Adler (University of Washington)
08:20	976	First Principles Modeling of Oxygen Incorporation into SOFC Cathode and Oxygen Permeation Membranes E. Kotomin, R. Merkle (Max Planck Institute for Solid State Research), Y. Mastrikov (University of Latvia), M. M. Kuklja (University of Maryland), and J. Maier (Max Planck Institute for Solid State Research)
08:40	977	Three-Dimensional Simulation of SOFC Anode Polarization Characteristics Based on Sub-Grid Scale Model M. Kishimoto (Kyoto University), H. Iwai (Tokyo Institute of Technology), M. Saito, and H. Yoshida (Kyoto University)
09:00	978	Modeling the Electrochemistry of an SOFC through the Electrodes and Electrolyte E. Ryan, K. Recknagle, and M. A. Khaleel (Pacific Northwest National Laboratory)
09:20	979	Computational Study on Impurities Poisoning and Degradation of an SOFC Anode Based on Density Functional Theory T. Ogura, K. Nakao, T. Ishimoto, and M. Koyama (Kyushu University)
09:40		Intermission (20 Minutes)
10:00	980	Multi-Scale Modeling of Solid Oxide Fuel Cells: From Patterned Anodes to a Power Plant System W. G. Bessler (German Aerospace Center)
10:20	981	Simulation of Two-Dimensional Electrochemical Impedance Spectra of Solid Oxide Fuel Cells Using Transient Physical Models Y. Shi, H. Wang, and N. Cai (Tsinghua University)
10:40	982	Mathematical Modeling and Simulation for Optimization of IDEAL-Cell Performance A. Bertei, C. Nicolella, F. Delloro (Università di Pisa), W. G. Bessler (German Aerospace Center), N. Bundschuh (Visimbel), and A. Thorel (Mines-ParisTech)
11:00	983	Modeling Segmented-in-Series SOFCs with Distributed Charge-Transfer and Internal-Reforming H. Zhu and R. J. Kee (Colorado School of Mines)
11:20	984	A Three Dimensional Electrical Model of SOFC Stack M. Le-Ny, O. Chadebec, G. Cauffet (Université Joseph Fourier), J. Dedulle (LMGP-GINP), and Y. Bultel (Université Joseph Fourier)
11:40	985	Analytical Models for SOFC Electrodes with Variable Cross-Section Microstructures G. Nelson, A. Peracchio, B. Cassenti, and W. K. Chiu (University of Connecticut)

Room 516C, Level 5

SOFC Interconnect and Seal Materials

Co-Chairs: Jeff Fergus and Jari Kiviaho

Time	Progr#	Title and Authors
08:00	986	Development of New Alloys for SOFC Interconnects with Excellent Oxidation Resistance and Reduced Cr-Evaporation N. Yasuda, T. Uehara, S. Tanaka, and K. Yamada (Hitachi Metals, Ltd.)
08:20	987	Low-Chromium Alloys for Solid Oxide Fuel Cell Interconnects J. Fergus and Y. Zhao (Auburn University)
08:40	988	Oxide Modification by Alloying Molybdenum to Fe-22Cr-0.5Mn for Solid Oxide Fuel Cell Interconnect D. Yun, H. Seo (Pohang University of Science and Technology), J. Jun, J. Lee, D. Kim (Research Institute of Industrial Science and Technology), and K. Kim (Pohang University of Science and Technology)
09:00	716	High Temperature Oxidation of Plastically Deformed Ferritic Interconnect Steel U. Bexell, M. Olsson (Dalarna University), and M. W. Lundberg (AB Sandvik Materials Technology)
09:20	990	Oxide Protective Coatings for Solid Oxide Fuel Cell Interconnects M. Seabaugh, S. Ibanez, M. Beachy, M. Day, and L. Thrun (NexTech Materials, Ltd.)
09:40		Intermission (20 Minutes)
10:00	991	On Potential Application of Coated Ferritic Stainless Steel Grades K41X and K44X in SOFC/HTE Interconnects P. O. Santacreu, P. Girardon (ArcelorMittal Isbergues Research Center), M. Zahid (European Institute for Energy Research), J. Van Herle (Ecole Polytechnique Fédérale de Lausanne), J. Mougin (Commissariat à l'Energie Atomique), and V. Shemet (Forschungszentrum Jülich GmbH)
10:20	992	Electrodeposition of CoMn onto Stainless Steels Interconnects for Increased Lifetimes in SOFCs T. D. Hall, H. McCrabb (Faraday Technology, Inc.), J. Wu, H. Zhang, X. Liu (West Virginia University), and J. Taylor (Faraday Technology, Inc.)
10:40	993	Multifunctional Nano-Coatings for SOFC Interconnects J. Froitzheim and J. Svensson (Chalmers University of Technology)
11:00	994	Nanocrystalline $MnCo_2O_{4-\delta}$ as SOFC Protective Coating A. Das Sharma, J. Mukhopadhyay, and R. N. Basu (Central Glass and Ceramic Research Institute)
11:20	722	Characteristics of the Sintered Phlogopite Mica SiO_2-B_2O_3-Al_2O_3-BaO-La_2O_3 Glasses Blends C. Liu, K.

Lin, and R. Lee (Institute of Nuclear Energy Research)

11:40	996	Analysis of Joint Strength between a Metallic Interconnect and Glass-Ceramic Sealant for Use in Solid Oxide Fuel Cells C. Lin, J. Chen (National Central University), L. Chiang, and S. Wu (Institute of Nuclear Energy Research)

Room 517A, Level 5

SOFC Modelling II

Co-Chairs: Wolfgang Bessler and Koichi Eguchi

Time	Progr#	Title and Authors
14:00	997	Multiscale Simulation of Electro-Chemo-Mechanical Coupling Behavior of PEN Structure under SOFC Operation K. Terada, T. Kawada, K. Sato, F. Iguchi, K. Yashiro, K. Amezawa, M. Kubo, H. Yugami, T. Hashida, J. Mizusaki, H. Watanabe, H. Aoyagi, and K. Takahashi (Tohoku University)
14:20	998	Numerical and Experimental Analysis of a Solid Oxide Fuel Cell Stack A. D. Le, S. Beale (National Research Council, Canada), J. Pharoah, H. Choi (Queen's-RMC Fuel Cell Research Centre), L. De Haart, and D. Froning (Forschungszentrum Jülich GmbH)
14:40	999	Modeling of a SOFC Fuelled by Methane: Influence of the Methane Steam Reforming Kinetics K. Girona, J. Toyir, P. Gélin (Université Claude Bernard Lyon 1), and Y. Bultel (Université Joseph Fourier)
15:00	1000	Thermodynamic Influence Analysis of Available Fuels and Reforming Methods on SOFC System Efficiency M. Heddrich, M. Jahn (Fraunhofer Institute for Ceramic Technologies and Systems), A. Michaelis (Fraunhofer Institute of Ceramic Technologies and Systems), and E. Reichelt (Fraunhofer Institute for Ceramic Technologies and Systems)
15:20		Intermission (20 Minutes)
15:40	1001	Multi-Dimensional Micro-Scale Model for Oxygen Reduction on LSM-YSZ Cathode S. R. Pakalapati, I. Celik, H. O. Finklea, M. Gong, and X. Liu (West Virginia University)
16:00	1002	A near Triple-Phase Boundary Region Model for H_2S Poisoning of SOFC Anodes D. S. Monder and K. Karan (Queen's-RMC Fuel Cell Research Centre)
16:20	970	An Innovative Electrochemical Model for Three-Dimensional Modeling of a SOFC Stack Use in Electrolysis Mode D. Grondin (University of La Reunion), J. Deseure (CNRS Grenoble INP-UJF), A. Brisse, M. Zahid (European Institute for Energy Research), B. Grondin-Perez, J. Chabriat (University of La Reunion), and P. Ozil (CNRS Grenoble INP-UJF)
16:40		Concluding Remarks - Koichi Eguchi (20 Minutes)

Room 516C, Level 5

Solid Oxide Electrolysis

Co-Chairs: Niels Christiansen and Subhash Singhal

Time	Progr#	Title and Authors
14:00	1004	Materials for Solid Oxide Electrolysis Cells S. Elangovan, J. Hartvigsen, D. Larsen, I. Bay, and F. Zhao (Ceramatec, Inc.)
14:20	1005	Experimentally Validated Simulations of Undoped Ceria Electrodes for H_2 Oxidation and H_2O Electrolysis in Solid Oxide Electrochemical Cell Electrodes S. C. DeCaluwe and G. Jackson (University of Maryland)
14:40	1006	Development of Reversible Solid Oxide Fuel Cell (RSOFC) Cells and Stacks N. Q. Minh (University of California, San Diego)
15:00	1007	Performance and Durability of High Temperature Steam Electrolysis: From the Single Cell to the Short-Stack Scale M. Petitjean, M. Reytier, A. Chatroux, L. Bruguière, A. Mansuy, H. Sassoulas, S. Di Iorio, and B. Morel (Commissariat à l'Energie Atomique)
15:20		Intermission (20 Minutes)
15:40	1008	Long Term Testing of Short Stacks with Solid Oxide Cells for Water Electrolysis J. Schefold, A. Brisse, M. Zahid (European Institute for Energy Research), J. Ouweltjes (Energy Research Centre of the Netherlands), and J. Nielsen (Topsoe Fuel Cell A/S)
16:00	1009	Hydrogen and Power by Fuel-Assisted Electrolysis Using Solid Oxide Fuel Cells G. Tao (Materials and Systems Research, Inc.) and A. Virkar (The University of Utah)
16:20	1010	Production of Sustainable Fuels by Means of Solid Oxide Electrolysis J. B. Hansen (Haldor Topsøe A/S), N. Christiansen, and J. Nielsen (Topsoe Fuel Cell A/S)
16:40		Concluding Remarks - Subhash Singhal (20 Minutes)

Characteristics of the Sintered Phlogopite Mica/ SiO_2-B_2O_3-Al_2O_3-BaO-La_2O_3 Glass Blends

Chien–Kuo Liu, Kin–Fu Lin, and Ruey–Yi Lee

Nuclear Fuels and Materials Division
Institute of Nuclear Energy Research
Taiwan, R.O.C.

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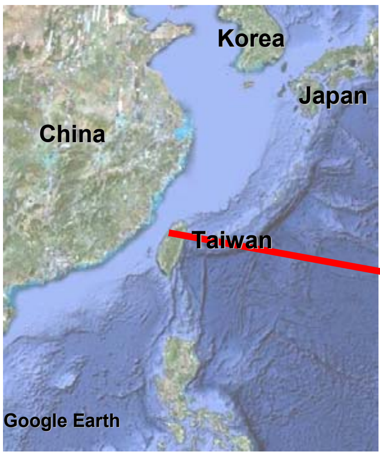
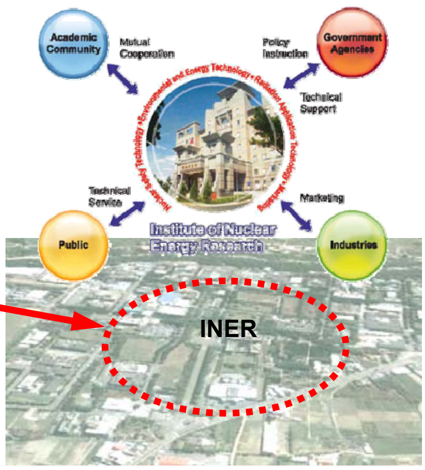
Montréal, Canada, May 1-6, 2011

Institute of Nuclear Energy Research

IC&Seals R&D Group

Institute of Nuclear Energy Research, Atomic Energy Council, Executive Yuan, Taiwan (R.O.C)





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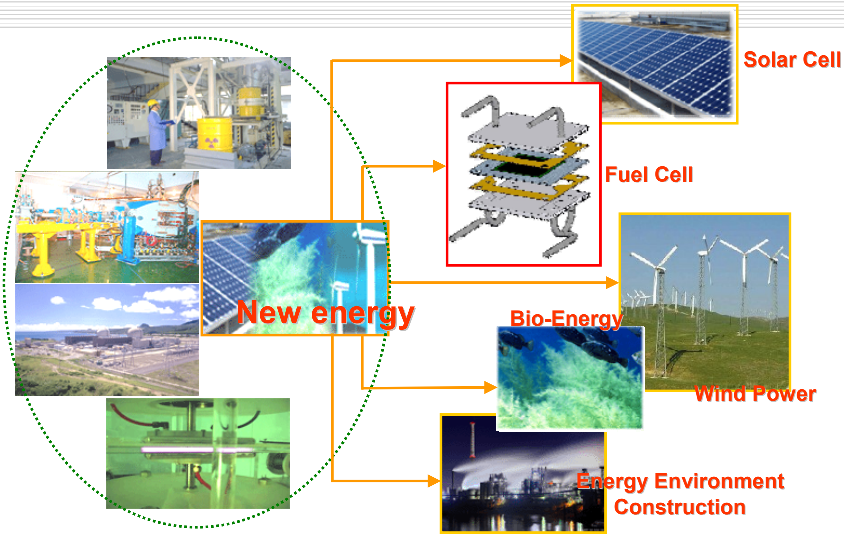

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Outline

- Introduction
- Motivation & Objectives
- Experimental
- Results & Discussion
- Conclusions

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Introduction

- Glass-ceramic and Mica are used in the SOFC as rigid and compressive sealing materials, respectively.
- For a BAS glasses system, it usually contains a large amount of BaO for yielding a high CTE to compatible with that of other SOFC stack components. However, Ba can easily react with the Cr to form the $BaCrO_4$ at high temperatures and accumulate at interface and then cause the failure of sealing after long term operation.
- The advantages of using mica as the high-temperature sealant include simplified sealing process at high temperature and regardless of CTE compatibility with adjacent components.
- Chou et al. reported that the low leak rate could be achieved by introducing glass to mica to form a hybrid seals.
- In this study, we investigate the characteristics of the sintered Phlogopite mica/GC9 glass blends with the weight fraction of mica from 0 to 100%.

IC&Seals R&D Group

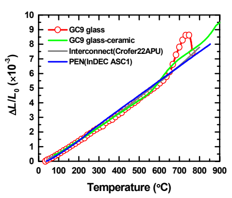
Introduction

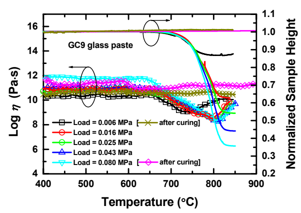
- GC9 glass is a kind of BAS glass, which is developed by INER for SOFC as a high-temperature seals.

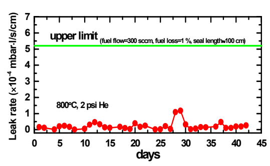
The composition of GC9 glass (in mol%)

SiO_2	Al_2O_3	B_2O_3	BaO	CaO	La_2O_3	ZrO_2
25~40	1~10	2~15	25~40	2~15	0.1~10	0.1~5

*Patent : "Glass-ceramic sealant for planar solid oxide fuel", US7897530B2 (2011).







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Introduction

ITEM	UNIT	REMARKS
Glass System		BAS
Composition	mol%	
Color		Transparent yellow(A) Milk white(C)
Density	g/cm^3	4.34
Smelting Temperature	ºC	1550
Glass transition Temperature	ºC	668
Crystallization Temperature	ºC	820, 864
Crystalline Phases		$Ba_3La_6(SiO_4)_6$ (for bulk) $Ba_3La_6(SiO_4)_6$ $BaSiO_3$ (for powder) α-$Ba(Al_2Si_2O_8)$
Softening Temperature	ºC	745 (for G) 825 (for G/C)
CTE(50~650ºC)	ºC^{-1}	12.5×10^{-6} (for G) 13.1×10^{-6} (for G/C)
Viscosity	Pa·s	10^8 (at 806ºC and under 0.08 MPa load applied)
Average Leak Rate	mbar·l/s/cm	2.25×10^{-5} (800ºC, 2 psi He, 0.03 MPa load applied)
Sealing Temperature		850ºC

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Motivation & Objectives

Motivation:

To reduce the Ba contents in the glass and improve the high-temperature mechanical strength by hybrid seals.

Objectives:

- CTE: 10~13 ppm/ºC (compatible with MEA and IC)
- T_s: ≈ 800ºC (≈ operation Temp.)
- Viscosity: 10^5~10^8 Pa·s (under sealing)
  ≥ 10^8 Pa·s (under operating)
- Leak rate: < 10^{-4} mbar·ℓ/s/cm
- Thermal and chemical stability
- Long term durability
- Stronger high-temperature mechanical strength

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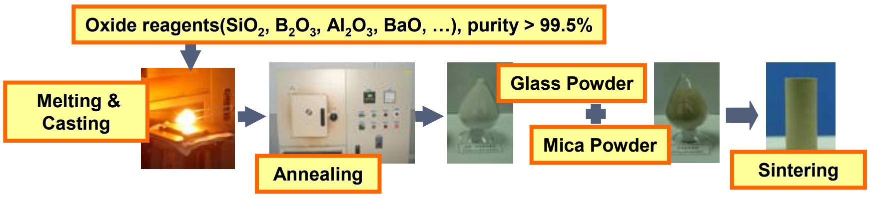
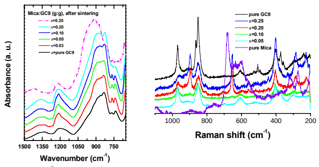
Experimental Procedures

- **Materials and Sample preparation**



- **Density and CTE measurement**
- **Observation of Shape Change at Elevated Temperatures**
- **XRD analysis and Microstructure Observation**
- FT-IR and Raman Analysis
- High temperature viscosity measurement
- Leakage rate test
- High-temperature mechanical strength measurement



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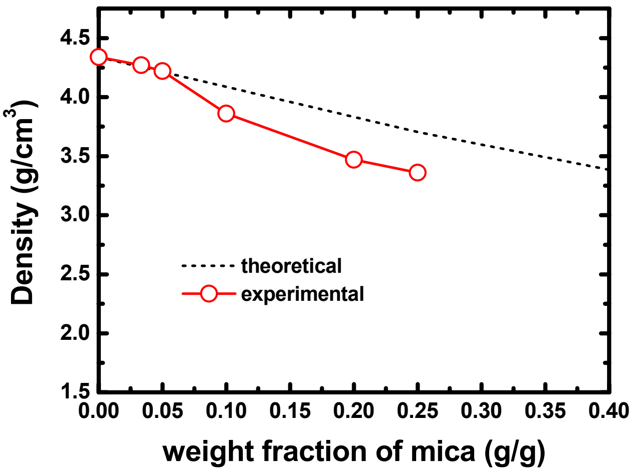
Results & Discussion – Density & CTE



†Data were obtained using balance (Mettler H33AR, Switzerland) with a density determination kit

Results & Discussion – Density & CTE

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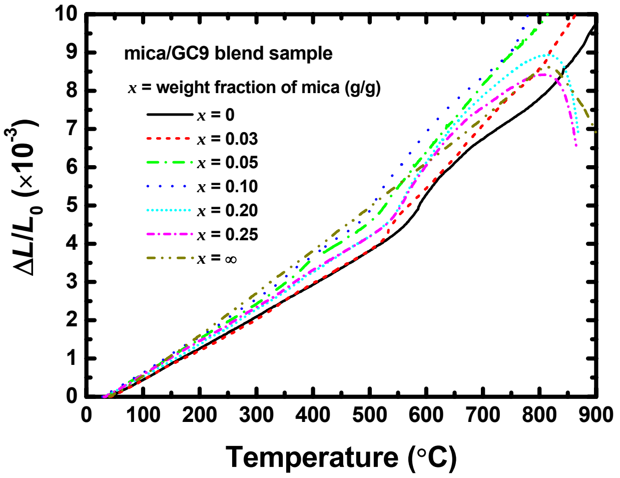

†Data were obtained using a high temperature dilatometer (SETARAM DHT 2050kN, France).

Results & Discussion – Shape Change

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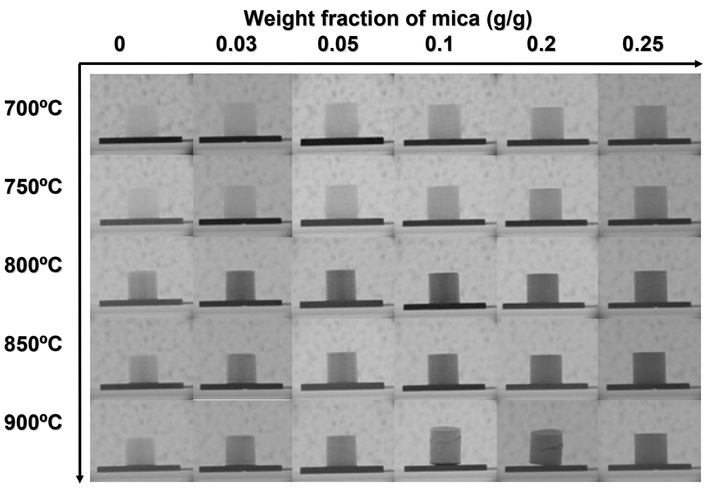
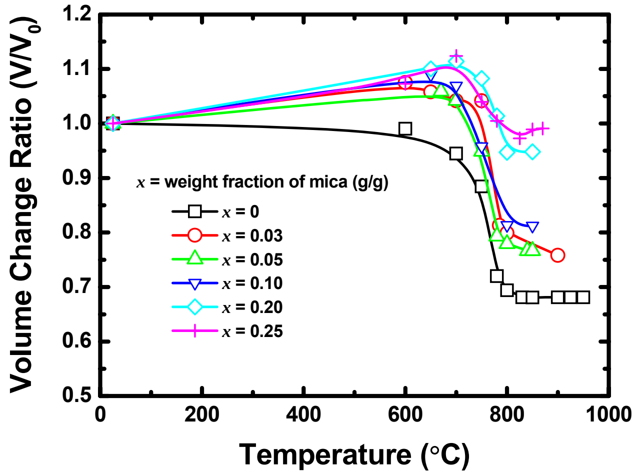


†Photos were taken using a CCD camera.

Results & Discussion – Shape Change



†Data were calculated according to the photographs of sample's shape change.

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Results & Discussion – Density, CTE & Shape Change

TABLE Characteristics of the sintered Phlogopite mica/GC9 glass blends

Weight fraction of mica (g/g)	Shrinkage (V/V_0–1)	Weight loss (W/W_0–1)	Density (g/cm^3)	CTE† (×10^{-6} °C^{-1})
0	–20.1%	–0.3%	4.34	10.6
0.033	–11.4%	–0.4%	4.27	14.4
0.05	–6.0%	–1.1%	4.22	15.3
0.1	–7.0%	–1.5%	3.86	18.1
0.2	–9.7%	–1.0%	3.47	11.8
0.25	–4.1%	–0.9%	3.36	9.7
1	+3.0%	–1.3%	2.11	11.1

† Data were calculated at 750°C.

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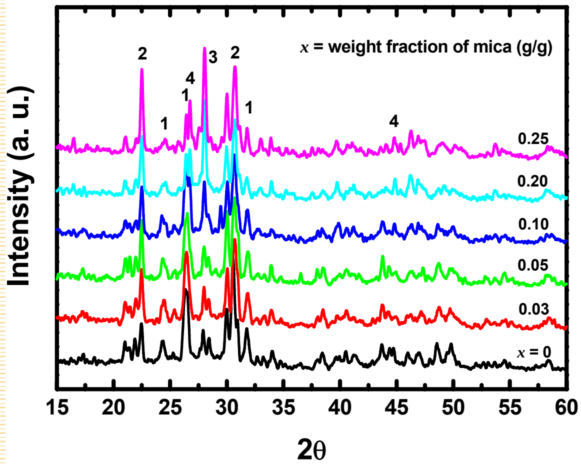
Results & Discussion – XRD Analysis



"1" $BaSiO_3$ (Orthorhombic)

"2" $BaAl_2Si_2O_8$ (Monoclinic)

"3" Al_2SiO_5 (Triclinic)

"4" Mica (Monoclinic)

* $Ba_3La_6(SiO_4)_6$ (Hexagonal) for GC9

†Analysis were conducted using a X-ray diffractometer (Burker D8 Discover, Germany).

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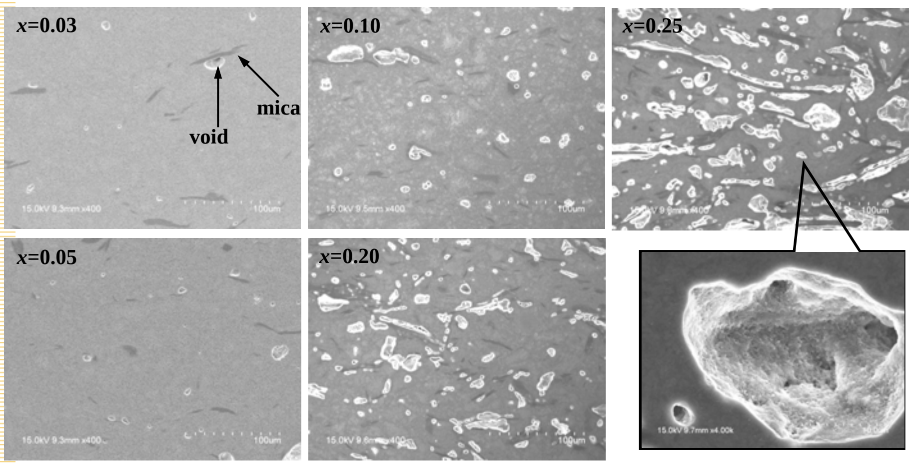
Results & Discussion – Microstructure



x : weight fraction of mica (g/g)

†Micrographs were taken using an FE-SEM (Hitachi S-4800, Japan).

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Results & Discussion – Microstructure

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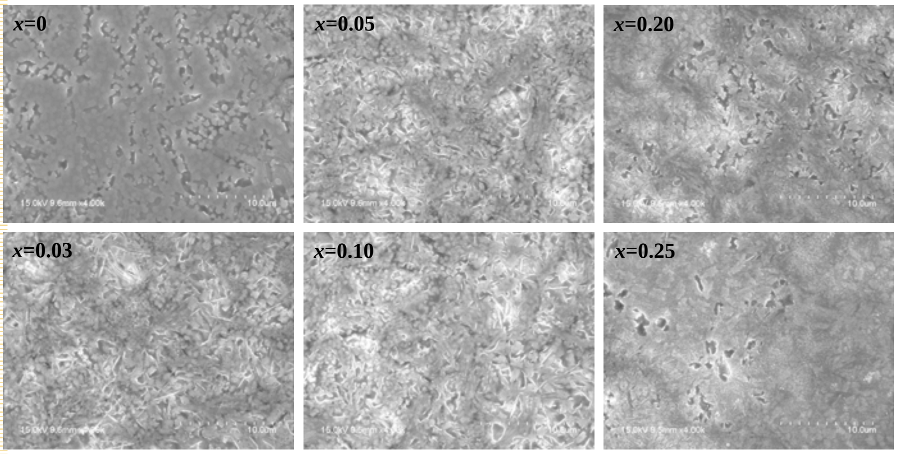

x : weight fraction of mica (g/g)

†Micrographs were taken using an FE-SEM (Hitachi S-4800, Japan).

Conclusions

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- Physical, thermal, and crystalline properties of the sintered Phlogopite mica/GC9 glass blends with the different weight fraction of mica have been investigated.
- A small amount of Phlogopite mica addition raises the coefficient of thermal expansion (CTE). However, the CTE of the blends decrease as the mica contents higher than 10 wt%.
- In this study, the range of CTE varies from 9.7 to 18.1 ppm/°C. It is found that the void formed in the interface between mica and GC9 glass at elevated temperatures. The amount of voids and void sizes increase as the content of mica increases and most of voids are closed pores.
- The crystalline phases of $BaSiO_3$ and $BaAl_2Si_2O_8$ exist in the sintered Phlogopite mica/GC9 glass blends. The amount of $BaSiO_3$ phase increase with mica addition and exists a maximum at the weight fraction of mica around 10%. In addition, the amount of $BaAl_2Si_2O_8$ phase increase with mica addition in the blends.

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Thank You for Your Attention!

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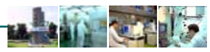

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Technical Exhibit

The Technical Session coffee break is scheduled for 0930h in Room 517BCD, Level 5, on Tuesday and Wednesday to allow meeting attendees additional time to browse through the exhibits. The exhibit will feature instruments, materials, systems, publications, and software of interest to attendees.

Exhibit Hours

Monday, May 2 .... 1800-2000h
includes the Monday Evening Poster Session

Tuesday, May 3 .... 0900-1400h
includes Technical Session Coffee Break

re-opening 1800-2000h
includes the Tuesday evening Poster Session

Wednesday, May 4 .... 0900-1300h
includes Technical Session Coffee Break

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