

# PROSPECTS PROTONIC CERAMIC CELLS 2013

## International Workshop

### *Protonic Ceramic Fuel Cells Status & Prospects*

10 – 12 July 2013  
Hotel Mercure Centre  
Montpellier, France

## SCIENTIFIC PROGRAMME

### Chair

Dr MARRONY Mathieu  
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# ORAL SESSION

## WEDNESDAY 10 JULY

8:30 – 9:00 Registration

**M. Marrony - EIFER, Germany**

9:00 – 9:15 Welcome

### SPECIAL SESSION – FUNDAMENTAL STUDIES OF PCC HURDLES

CHAIRMAN: DR. M. MARRONY

9:15 – 10:00 **Pr. R. Kee - Colorado School Mines, USA – Keynote Lecture**

*Transport theory in (mixed) protonic conductors*

10:00 – 10:45 **Dr. Y. Yamazaki - CIT, USA: Keynote Lecture**

*Proton trapping: a guide for proton conducting oxide electrolyte development*

10:45 – 11:00 **Coffee Break**

11:00 – 11:45 **Pr. P. Slater - Uni. Birmingham, United Kingdom – Keynote Lecture**

*Fundamental Studies of Fuel Cell Electrolyte Materials: Compositional Gradients and Effect of Sintering Aids*

11:45 – 12:30 **Dr. P. Baranek - EDF R&D, France – Keynote Lecture**

*Illustrations of the atomic modeling used to understand the chemical stability and the protonic diffusion in the PCFC electrolytes*

12:30 – 14:00 **Lunch**

### SESSION 1 - PROTON CONDUCTING OXIDE- BASED MATERIALS DEVELOPMENT: TOWARDS THE BEST PERFORMANCES...

CHAIRMAN: DR. G. COORS

#### BULK PROTON TRANSPORT MECHANISM AND ADVANCED PROCESSING STRATEGIES

14:00 - 14:45 **Dr. R. Peng - USTC, China – Keynote Lecture**

*Ab-initio investigation of bulk transport and surface catalytic mechanisms on  $Ba_{1-x}Zr_xO_3$  cathode materials in Solid Oxide Fuel Cells*

14:45 - 15:15 **Mr. F. Lenrick - Uni. Lund, Sweden**

*Transmission Electron Microscopy characterisation of thin film materials for protonic ceramic fuel cells prepared by Focused Ion Beam*

15:15 – 15:45 **Pr. P. Colomban - ADIR UMPC, France**

*Autoclave testing of the chemical stability of ceramic membranes: surface reactions or bulk protonation in perovskite frameworks?*

15:45 – 16:15 **Dr. Domingo Pérez-Coll - CSIC, Spain**

*Transport-Number Determination of a Protonic Ceramic Electrolyser Membrane via the Gorelov Electrode Polarisation Correction*

16:15 – 16:30 **Coffee Break**

**GRAIN BOUNDARY RESISTANCE STUDIES, ELECTROLYTE DOPING STRATEGIES AND NOVEL STRUCTURE**

**CHAIRMAN: DR. G. TAILLADES**

- 16:30 – 17:00** **Dr. Y-C. Kim - KUTE, Korea**  
*Proton migration at  $\Sigma 3$  tilt grain boundaries of barium zirconate and barium cerate*
- 17:00 – 17:30** **Dr. S. Ricote - Colorado School of Mines, USA**  
*Grain boundary composition by atom probe tomography and conductivity of  $\text{BaZr}_{0.9}\text{Y}_{0.1}\text{O}_{3-\delta}$  prepared by three different methods*
- 17:30 – 18:00** **Dr. Y. Liu - Uni. Nanjing, China**  
*Improving proton conductivity of  $\text{BaCe}_{0.9}\text{Y}_{0.1}\text{O}_{3-\delta}$  perovskite oxide protonic conductor through a Pd catalytic approach*
- 18:00 – 18:30** **Pr. H. Matsumoto - Uni. Kyushu, Japan**  
*Impact of transition metal doping on proton conduction properties of alkali earth cerates and zirconates performance of infiltrated cathodes on protonic ceramic fuel cells*
- 18:30 – 20:00** **Poster session and appetizer**

## THURSDAY 11 JULY

### GRAIN BOUNDARY RESISTANCE STUDIES, ELECTROLYTE DOPING STRATEGIES AND NOVEL STRUCTURE

CHAIRMAN: PR. J. ROZIÈRE

- 9:00 – 9:30** **Dr. S. Escolastico - CSIC-ITQ, Spain**  
*Optimization of the hydrogen transport through  $La_{5.5}WO_{11.25-\delta}$  based membrane by selective doping*
- 9:30- 10:00** **Mr. F. Kinyanjui - DCBE, Uni. Chalmers, Sweden**  
*Protonic conduction in oxygen deficient  $Ba_3In_{1.4}Y_{0.3}M_{0.3}ZrO_8$  ( $M = Gd^{3+} / Ga^{3+}$ ) electrolytes*
- 10:00 – 10:30** **Dr. A. Smith - Uni. Birmingham, United Kingdom**  
*Synthesis and Characterization of Oxyanion (Phosphate and Sulfate) doped  $Ba_2Sc_{2-y}GayO_5$  and  $Sr_2Sc_{2-y}GayO_5$*
- 10:30 – 10:45** Coffee Break

### SESSION 2- PROTON CONDUCTING OXIDE - BASED CELL MANUFACTURING: TOWARDS THE BEST ARCHITECTURE...

CHAIRMAN: DR. N. BONANOS

#### NOVEL ANODE ARCHITECTURE

- 10:45 – 11:30** **Dr. B-K. Kim - KIST, Korea: Invited speaker – Keynote Lecture**  
*Novel Strategies to Fabricate an Anode Supported-Type Protonic Ceramic Fuel Cells (PCFCs) with Dual Layer Electrolyte*
- 11:30 – 12:00** **Dr. M. Parco - TECNALIA, Spain**  
*Development of anodes for proton conducting fuel cells by thermal spraying*
- 12:00 – 12:30** **Dr. D. Fagg - Uni. Aveiro, Portugal**  
*Novel nitrate-free combustion route and electrochemical study of  $Ni-BaZr_{0.85}Y_{0.15}O_{3-\delta}$  anodes*
- 12:30 – 14:00** Lunch

#### NOVEL CATHODE ARCHITECTURE AND CELL FABRICATION

CHAIRMAN: DR. S. RICOTE

- 14:00 – 14:30** **Dr. S. Babiniec - Colorado School of Mines, USA**  
*Performance of infiltrated cathodes on protonic ceramic fuel cells utilizing thin  $BaCe_{0.2}Zr_{0.7}Y_{0.1}O_{3-\delta}$  electrolytes*
- 14:30 – 15:00** **Dr. L. Navarette - CSIC-ITQ, Spain**  
*Tailor-made electrodes for LWO based PC-SOFC*
- 15:00 – 15:30** **Dr. P. Batocchi - ICMCB, France**  
*Influence of water partial pressure on electrical and electrochemical properties of perovskite and A2MO4-type oxides used as cathode materials for Protonic Ceramic Fuel Cell*
- 15:30 – 16:00** **Dr. E. Quarez - IMN, France**  
*Compatibility of new proton conductor electrolytes with standard cathode materials*
- 16:00 – 16:15** Coffee Break

SESSION 3 - SYSTEM ARCHITECTURE AND SCALING-UP

CHAIRMAN: DR. M. PARCO

- 16:15 – 17:00** **Dr. ML. Fontaine - SINTEF, Norway – Keynote Lecture**  
*Proton conducting fuel cells: interplay of Design, manufacturing and application*
- 17:00 – 17:30** **Dr. S. Molin - DTU, Denmark**  
*High temperature corrosion of stainless steels for potential use as interconnects in Proton Conducting Fuel Cell stacks*
- 17:30 – 18:00** **Dr. J. Dailly - EIFER, Germany**  
*Recent results in up scaling approach strategy by wet chemical routes in EIFER*
- 18:00 – 18:30** **Mr. A. Manerbino - CoorsTek, USA**  
 $H_2$  flux through dense tubular  $BaCe_{0.2}Zr_{0.7}Y_{0.1}O_{3-\delta}$  membranes as a function of temperature and hydrogen partial pressure
- 20:00** **Gala Dinner**

SESSION 4 - PROTON CONDUCTING OXIDE- BASED SYSTEM APPLICATIONS AND RELIABILITY: WHERE WE ARE?  
CHAIRMAN: PR. H. MATSUMOTO

**08:45 - 9:30** **Pr M. Stoukides - CERTH, Greece – Keynote lecture**  
*Applications of Proton Conductors in Heterogeneous Catalysis. The Example of Solid State Ammonia Synthesis*

HYDROGEN PUMPING APPLICATION /AMMONIA SYNTHESIS

**9:30 – 10:00** **Dr. A.Brandao - Uni. Aveiro, Portugal**  
*Study of (SrLa)(NbV)O<sub>4</sub>-based composite as a hydrogen permeation membrane*

**10:00 - 10:30** **Mr. S. Robinson - Colorado School of Mines, USA**  
*Galvanic Hydrogen Flux and Fuel Cell Performance of Tubular Protonic Ceramic BaCe<sub>0.2</sub>Zr<sub>0.7</sub>Y<sub>0.1</sub>O<sub>3-δ</sub> Membranes*

**10:30 – 11:00** **Dr G. Coors - CoorsTek, USA**  
*One Million Liter per Day Gas-to-Liquid Refinery*

**11:00 – 11:15** Coffee Break

FUEL CELL APPLICATION

**11:15 – 11:45** **Dr. Y. Liu - Uni. Nanjing, China**  
*A novel approach for substantially improving the sinterability of BaZr<sub>0.4</sub>Ce<sub>0.4</sub>Y<sub>0.2</sub>O<sub>3-δ</sub> electrolyte for fuel cells by impregnating green membrane with zinc nitrate as sintering aid*

**11:45 – 12:15** **Dr. A. Magraso - Uni. Oslo, Norway**  
*Performance of LaNbO<sub>4</sub>-based proton conducting fuel cell*

**12:15 – 12:45** **Dr. H. Lee - Uni. Hanyang Korea**  
*Enhanced electrochemical performance of BaZr<sub>0.15</sub>Ce<sub>0.7</sub>Y<sub>0.15</sub>O<sub>3-δ</sub>-based proton-conducting solid oxide fuel cells with continuous graded SSC-BZCY composite cathode by electrostatic spray slurry deposition*

HYDROGEN PRODUCTION APPLICATION

**12:45 – 13:15** **Dr. Y. Yoo - EME NRC, CA**  
*PCC electrical performances & reliability under reversible profile: status and prospects*

**13:15 – 13:45** Conclusion

**13:45 - 14:45** Lunch

# POSTER SESSION



## POSTER LIST



- Dr. S. Ricote - Colorado School of Mines, USA**  
P1 *Lan+1NinO3n+1 (n=1, 2, 3) as potential cathode materials for protonic ceramic fuel cells: hydration properties and performance*
- Dr. P. Pasierb - AGH Uni. Krakow, Poland**  
P2 *Novel approach towards stable BaCeO<sub>3</sub> composite protonic conductors with high ionic conductivity*
- Dr. A. Lacz - AGH Uni. Krakow, Poland**  
P3 *Grain boundary modification of BaCeO<sub>3</sub>-based composites controlled by synthesis path*
- Dr. A. Chinelatto - CSIC, Spain**  
P4 *Synthesis, Structures and Proton Conductivity of the 12R-type Hexagonal Perovskite Solid Solution Sr<sub>3</sub>NdNb<sub>3-x</sub>Ti<sub>x</sub>O<sub>12-δ</sub> (0 ≤ x ≤ 0.06)*
- Dr. N. Bonanos - DTU, Denmark**  
P5 *Impedance response of BaCe<sub>0.2</sub>Zr<sub>0.7</sub>Y<sub>0.1</sub>O<sub>3-δ</sub>/Sr<sub>0.95</sub>Ti<sub>0.9</sub>Nb<sub>0.1</sub>O<sub>3-δ</sub> (BCZY27/STN95) composite at near-ambient temperatures*
- Dr. C. Knee - Uni. Chalmers, Sweden**  
P6 *Role of B-site ion on Proton Conduction in Acceptor-doped Sm<sub>2</sub>B<sub>2</sub>O<sub>7-δ</sub> (B = Ti, Sn, Zr and Ce) Pyrochlores and C-type Compounds*
- Dr. M. Arab pour Yazdi - IRTES-LERMPS-UTBM, France**  
P7 *BaZr<sub>1-x</sub>Y<sub>x</sub>O<sub>3-α</sub> thin film deposited at high temperatures on commercial PCFC-anodes by reactive magnetron sputtering*
- Dr. I. Antunes - CICECO, Uni. Aveiro, Portugal**  
P8 *Structure Property Relations of A- and B- site Pr doped BaTiO<sub>3</sub>*
- Dr. C. Mortalo - CNR-IENI, Italy**  
P9 *Electrochemical investigation and chemical compatibility between Ln<sub>2</sub>NiO<sub>4+δ</sub> cathode materials and BaCe<sub>0.65</sub>Zr<sub>0.20</sub>Y<sub>0.15</sub>O<sub>3-δ</sub> electrolyte for PCFC application*