



OSSEP/ESF

**Ionic and Mixed Conductors: Methods and
Processes**

Aveiro, Portugal, April 10-12, 2003

Scientific Report

The Workshop on **‘Ionic and Mixed Conductors: Methods and Processes’** was attended by 56 participants, from Denmark, France, Germany, Norway, Portugal, Russia, Slovenia, Spain, Switzerland, The Netherlands, and UK. 42 participants presented oral contributions. Every contribution was discussed after its presentation, and the main conclusions were summarised at the end of the sessions.

The workshop was organised in the following sub-topics:

- Transport properties and exchanged, chaired by J. Maier and M. Saiful Islam
- Crystallographic and microstructural aspects, chaired by J. Irvine and F. Figueiredo;
- Processing and synthesis, chaired by J.Schoonman and M.Mogensen;
- Proton conductors, chaired by T. Schober and T. Norby;
- Mixed conducting membrane materials, chaired by H.Bouwmeester

About 30 manuscripts were submitted for publication in a special issue of the Journal of Solid State Electrochemistry. Every manuscript was sent to at least 2 referees for peer revision. Most authors have already received refereeing reports, and publications is expected by the end of 2003.

The scientific program is attached

Ionic and Mixed Conductors: Methods and Processes, Aveiro, April 10, 2003

8h 40 min: J.R. Frade - Brief presentation

8h 50min: Transport Properties and Exchange: Chairman: J.Maier

8h 50min:M.Saiful Islam (m.islam@surrey.ac.uk)

Department of Chemistry, University of Surrey, Guildford GU2 7XH, UK

TP1-Atomistic Modelling of Conducting Oxides: Dopant Substitution, Defect Association and Surface Structures

9h 20 min: A.L. Shaula (ashaula@cv.ua.pt), V.V. Kharton, F.M.B. Marques,
dep. Ceramics and Glass Engineering, CICECO, University of Aveiro, 3810-193 Aveiro, Portugal

TP2 -Ionic and electronic transport in Fe-containing apatite phases

9h 40 min: Anna Lashtabeg (al12@st-and.ac.uk), and John T.S.Irvine

School of Chemistry, University of St Andrews, Room 219, Purdie Building, North Haugh, St Andrews
KY16 9ST, United Kingdom

TP3 -Synthesis and conductivity studies of the distorted perovskite $Sr_{1-x}NbO_3$

10h : Politova Ekaterina (politova@cc.nifhi.ac.ru),

L.Ya.Karpov Institute of Physical Chemistry, 10, Vorontsovo Pole st., Moscow, 105064, Russia

TP4-Processing, structure, microstructure, transport properties of the oxygen conducting ceramics $(La,Sr)(Ga,M)O_y$, (M=Mg, Fe, Ni).

10h 20 min: O.A. Smirnova (osmirnova@cv.ua.pt), I.P. Marozau, A.P. Viskup, V.V. Kharton, E.N. Naumovich, F.M.B. Marques

Dep. Ceramics and Glass Engineering, CICECO, University of Aveiro, 3810-193 Aveiro, Portugal

TP5 -A comparative study of ionic and electronic transport in Al-W(Mo)-O and La-W(Mo)-O phase

10h 40 min: Coffee/Tea Break

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11hr: Methods. Chairmen: B.Boukamp, J.Jamnik

11h min: **Bernard A. Boukamp** (B.A.Boukamp@utwente.nl)

University of Twente, Dept. of Chemical Technology, Lab. for Inorganic Materials Science, P.O. Box 217, 7500 AE Enschede, The Netherlands

M1 -Transport processes in mixed conducting oxides: combining time and frequency domain experiments/analysis

11h 30 min **Helfried Naefe** (naefe@mf.mpg.de)

M2 – “The behaviour of a solid electrolyte galvanic cell under load outlined for the example of the new electrolyte La₂Mo₂O₉

11h 50 min **Janez Jamnik** (janez.jamnik@ki.si)

National Institute of Chemistry, Hajdrihova 19, SI-1000 Ljubljana, Slovenia

M3 -What can impedance spectroscopy tell us about mixed conductors: Electrodes and blocking grain boundaries effects?

12h 10min **Juan Carlos Ruiz-Morales** (jcr7@st-andrews.ac.uk), John T. S. Irving and Pedro Nuñez

School of Chemistry, University of St Andrews, Scotland, UK,

M4 -A new alternative representation of impedance data

12h 30 min: **João C.C. Abrantes** (jabrant@estg.ipv.pt) and J.R. Frade

Instituto Politécnico de Viana do Castelo, IPVC, 4900 Viana do Castelo, Portugal

M5 -Computing tools for quick inspection and interpretation of impedance spectra

13h **Lunch/ Staff Restaurant -University of Aveiro**

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14h 30 min: Transport Properties and Exchange: Chair: M. Islam

14h 30 min: **Joachim Maier**

TP6 "Kinetics of Oxygen Exchange with Oxides"

15h: **Domingo P. Coll** (dpcoll@ull.es), P.Nuñez, J.C.C.Abrantes, J.R.Frade

Dep. Química Inorgánica, Universidade de La Laguna, Tenerife, Spain

TP7 -Effects of sintering additives on the mixed transport properties of ceria based materials under reducing conditions

15h 20 min: **Duncan Fagg** (duncan@cv.ua.pt), V.Kharton, J.R.Frade

Ceramics and Glass Eng. Dep., University of Aveiro, 3810-193 Aveiro

TP8 -Transport properties of CGO modified with sintering additives and their effects on oxygen reduction kinetics

15h 40 min **Charles Hatchwell** (Charles.edward.hatchwell@risoe.dk). M Mogensen

Materials Research Department, Risø National Laboratory, Roskilde

TP9: Fabrication and electrical characterisation of strontium and titanium-doped lanthanum scandate

16h: **David M. López**, P.Nuñez, J.C.C.Abrantes, J.R.Frade

Dep. Química Inorgánica, Universidade de La Laguna, Tenerife, Spain

TP10 -Transport properties of La₂Mo₂O₉-based materials

16h 20min **Jesús Canales** (jc52@st-andrews.ac.uk), J.T.S.Irvine

School of Chemistry, University of St Andrews, Fife KY16 9ST, UK.

TP11 La₂Sr_{n-2}Ti_nO_{3n+1}: Excess oxygen in perovskite phases.

16h 40 min: **Coffee/Tea Break**

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17h min: Crystallographic and Microstructural Aspects:

Chairmen: J.Irvine, F.M. Figueiredo

17h min: **J.T.S.Irvine** (jtsi@st-andrews.ac.uk),

School of Chemistry, University of St Andrews, St Andrews, Fife KY16 9ST, UK.

CM1 -Are zirconia fluorites ever cubic?

17h 20min: **F.M. Figueiredo** (framos@cv.ua.pt)

Ceramics and Glass Eng. Dep., University of Aveiro, 3810-193 Aveiro

CM2 -Crystallographic and microstructural features of Ca(Ti,Fe)O_{3-d} and their effects on transport properties

17h 40 min: **N.P. Vyshatko** (nvyshatko@cv.ua.pt), V.V. Kharton, F.M.B. Marques

Dep. Ceramics and Glass Engineering, CICECO, University of Aveiro, 3810-193 Aveiro, Portugal

CM3 -Structural aspects of oxygen ionic conduction in garnet-, brownmillerite- and perovskite-type ferrites

18h **Anna Chliakhtina** (annash@chph.ras.ru), N.N. Semenov Institute of Chemical

Physics, Russian Academy of Sciences

Kozigina Str. 4, 119991 Moscow, Russia

CM5- Study of the fluorite-pyrochlore-fluorite phase transitions in Ln₂Ti₂O₇ (Ln= Lu, Yb, Tm; Gd)

18h 20min- **Discussion**

19h 30 min: **Dinner/ Hotel Afonso V**

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8h 40 min: Processing and Synthesis: J.Schoonman, M.Mogensen

8h 40 min: **Joop Schoonman** (j.schoonman@tnw.tudelft.nl), Tracy Q. Gardner, Izumi Taniguchi

Delft University of Technology, Delft Institute for Sustainable Energy, Laboratory for Inorganic Chemistry
Julianalaan 136; 2628 BL Delft, The Netherlands

PS1 -Electrostatic Spray Deposition of electrode materials for IT-SOFC's

9h: **Salvador Piñol Vidal**, (salva@icmab.es)

Institut de Ciència de Materials de Barcelona-CSIC, Campus de la UAB. E-08193-Bellaterra. Barcelona, Spain.

PS2 -Microstructure-conductivity Relationship in Ceria-based Electrolytes SOFC's Prepared by Sol-Gel related Methods

9h 20 min : **A. Ringuedé** (ringuede@enscp.jussieu.fr), E. Gourba, M. Cassir

Laboratoire d'Electrochimie et de Chimie Analytique – UMR 7575 CNRS-ENSCP
11 rue Pierre et Marie Curie – 75231 PARIS Cedex 05 – France

PS3 -Ultra thin layers for Solid Oxide Fuel Cells

9h 40 min: **P.R. Slater** (p.slater@surrey.ac.uk), J.E.H.Sansom, J.Tolchard, M.S. Islam

Chemistry (C4), University of Surrey, Guildford, Surrey. GU2 7XH. UK

PS4 -Synthesis and sintering of Ge based apatite systems

10h : **E.V. Tsipis**, I.A. Bashmakov, V.V. Kharton, E.N. Naumovich, J.R. Frade

Ceramics and Glass Eng. Dep., CICECO, University of Aveiro, 3810-193 Aveiro, Portugal

PS5 – Cellulose precursor synthesis of ceria –containing SOFC anodes

10h 20 min **Petra Fedtke** (p.fedtke@et.hs-wismar.de), Marion Wienecke, Mihaela-C.

Bunescu, T. Barfels, K. Deistung, Marlis Pietrzak,

Hochschule Wismar, Philipp-Müller-Straße, PF 1210, 23952 Wismar

PS6 -YSZ-Films by Plasmaspraying and Sputtering

10h 40 min: **Coffee/Tea Break**

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11h: Proton Conductors: T. Schober

11h: **Truls Norby** (truls.norby@kjemi.uio.no)

Department of Chemistry, University of Oslo, Centre for Materials Science, Gaustadalleen 21, N-0349 Oslo, Norway

P1 -Measurements of partial hydrogen ion conductivity in oxidic materials under reducing conditions

11h: 20 min: **A. Magrez** (magrez@IWE.RWTH-Aachen.de)

IFF, Forschungszentrum Jülich, 52425 Jülich, Germany

P2 -Self combustion synthesis of the proton conductor $\text{BaZr}_{0.8}\text{Y}_{0.2}\text{O}_{3-d}$

11h 40 min: **Glenn Mather** (mather@icv.csic.es)

Instituto de Cerámica y Vidrio, CSIC, Camino de Valdelatas, s/n, Campus de Cantoblanco, 28049 Madrid, Spain

P3 -Structure and stability of A-site deficient perovskite proton conductors

12 h: **Emilia Bertolo** (maria.bertolo-pardo@ic.ac.uk), John A. Kilner, Mortaza Sahibzada

Centre for Ion Conducting Membranes. Department of Materials., Imperial College of Science, Technology and Medicine (London, UK)

P4 -Study of ion transport on Y- and Yb-doped perovskite-type oxides

12h 20min -**Emmanuelle Boehm** and Augustin McEvoy

Laboratory for Photonics and Interfaces, Institute of Biological and Molecular Chemistry, Swiss Federal Institute of Technology, 1015 Lausanne (Switzerland)

P5: Suitable cathodes for proton-conducting fuel cells?

12h 45 min: **Lunch/ Staff Restaurant-University of Aveiro**

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14h 30min Mixed Conducting Membranes Materials: H.Bouwmeester, E.Naumovich

14h 30min: **H.J.M. Bouwmeester** (h.j.m.bouwmeester@ct.utwente.nl), M.W. den Otter and B.A. Boukamp

University of Twente, Dept. of Chemical Technology, Inorganic Materials Science
PO Box 217, 7500 AE Enschede, The Netherlands

MC1 -Chemical diffusion and oxygen surface exchange of $\text{La}_{0.6}\text{Sr}_{0.4}\text{Co}_{1-y}\text{Fe}_y\text{O}_{3-d}$

14h 50 min: **E.N. Naumovich**^{a,b}, V.N. Tikhonovich^a, D.I. Logvinovich^a, V.V. Kharton^{a,b}, A.A. Vecher^a

^a Institute of Physicochemical Problems, Belarus State University, 14 Leningradskaya Str., 220050 Minsk, Belarus; ^b Dep. Ceramics and Glass Engineering, CICECO, University of Aveiro, 3810-193 Aveiro, Portugal

MC2 -Oxygen nonstoichiometry of $\text{Sr}(\text{Co,Fe})\text{O}_{3-d}$ mixed conductors

15h 10 min: **V.L.Kozhevnikov** (kozhevnikov@imp.uran.ru), J.A.Bahteeva, I.A.Leonidov, M.V.Patrakeev, K.R.Poeppelmeier, E.B.Mitberg

Institute of Solid State Chemistry, Ural Division of RAS, 91 Pervomaiskaia, Ekaterinburg 620219, Russia

MC3 -High-Temperature Electron and Ion Transport in $\text{La}_{1-x}\text{Sr}_x\text{FeO}_{3-d}$

15h 30 min **A.A. Yaremchenko** (ayaremchenko@cv.ua.pt), V.V. Kharton, A.L. Shaula, M.V. Patrakeev, J.R. Frade

Department of Ceramics and Glass Engineering, CICECO, University of Aveiro, 3810-193 Aveiro, Portugal

MC4 -Stability and mixed conductivity of Ni-containing phases with perovskite and K_2NiF_4 -type structure

15h 50 min

: **Stefan Marion** (stefanm@kjemi.uio.no)

University of Oslo, *Centre for Materials Science*
Gaustadalleen 21, 0349 Oslo, Norway

P6-Ceramic hydrogen permeable membranes

16h 10 min: **Diethelm Stefan** (stefan.diethelm@epfl.ch) Joseph Sfeir², Frank Clemens³, Jan Van herle¹ and Daniel Favrat

Swiss Federal Institute of Technology, STI, Laboratory for Industrial Energy Systems (LENI), CH-1015 Lausanne, Switzerland

MC6- Planar and tubular perovskite-type membrane reactors for the partial oxidation of methane to syngas

16h 30 min: **Coffee/Tea Break**

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16h 50min: Proton Conductors: Truls Norby

16h 50 min: **Cristian Savaniu**

School of Chemistry, University of St Andrews, St Andrews, Fife KY16 9ST, UK.

P6- Thin films of $\text{Sr}_3\text{CaZr}_{0.5}\text{Ta}_{1.5}\text{O}_{8.75}$ deposited on porous substrates

17h 10 min: **Danai Poulidi**

Dep. Chemical Engineering, University of Manchester, PO Box 88, M60 1QD Manchester, UK

P7: Preparation and characterisation of the $\text{BaCe}_{0.9}\text{Y}_{0.1}\text{O}_{3-a}$ high temperature proton conductor for fuel cell application

Other Contributions: Truls Norby

17h 30 min

A.V.Shlyahina, **L.G.Shcherbakova** (lshcherb@chph.ras.ru), A.V. Knopko

Institute of Chemical Physics RAS, 4 Kosyginab Str., Moscow 119991, Russia

PS7 – The influence of non-equilibrium state of the precursors on the synthesis and properties of $\text{Ln}_2\text{Hf}_2\text{O}_7$ (Ln= Tb, Gd, Lu).

17h 50 min **E. Chinarro**, (martin@icv.csic.es), J.R. Jurado

Instituto de Cerámica y Vidrio, CSIC, Camino de Valdelatas, s/n, Campus de Cantoblanco, 28049 Madrid, Spain

PS8- Catalysts Preparation for Electrochemical Hydrocarbon Devices by Combustion Synthesis

18h 10min **M.J.Ribeiro*** (ribeiro@estg.ipv.pt), A.A.L.Ferreira*, J.M.Ferreira**, J.A.Labrincha**

* ESTG, Polytechnique Institute of Viana do Castelo, 4900 Viana do Castelo, Portugal

**Ceramics and Glass Engineering Department, CICECO, University of Aveiro, 3810 –193 Aveiro, Portugal

PS9 - Electrical Characterization of Mullite/Alumina Bodies based on Al-rich Anodizing Sludge by Impedance Spectroscopy

18h 30: Discussion

19h 30 min: **Dinner/ Hotel Afonso V**

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8h 30 min: Meeting of the Scientific Committee

11h : Departure to Dão Region (wine making region)

13h 30 min: Lunch and visit to Quinta do Cabriz (wine producer)

18h: Visit to Buçaco

19h 30 min: Return to Aveiro

20h 30 min: Dinner/Hotel Afonso V