

Report on the Lorentz Workshop / COST Training School on Electrocatalysis@nanoscale: techniques and applications

Lorentz Center, Leiden University, The Netherlands
24-28 November 2008

Local Organizers: Prof. Dr. Marc Koper, Dr. Alex Yanson

International Organizers: Dr. David Fermin (Bristol), Prof. Dr. Patrick Unwin (Warwick)

Lorentz center • **Electrocatalysis@Nanoscale:**
Techniques and Applications
Workshop November 24 - 28 2008, Leiden, The Netherlands

Scientific Organizers

- M.T.M. Koper, Leiden
- A.J. Yanson, Leiden
- D.J. Fermin, Bristol
- P.R. Unwin, Warwick

Invited Speakers

- Helmut Baltruschat, Bonn
- Bernard Boukamp, Twente
- Robert Dryfe, Manchester
- Joost Frenken, Leiden
- Serge Lemay, Delft
- Julie Macpherson, Warwick
- Olaf Magnussen, Kiel
- Bruno Pettinger, Berlin
- Antonio Rodes, Alicante
- Elisabeth Santos, Cordoba
- David Schiffrin, Liverpool
- Wolfgang Schmickler, Ulm

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Electrocatalysis is a highly interdisciplinary discipline of science of great importance for our future energy economy (batteries, fuel cells, hydrogen production...). A good background in electrocatalysis, which would enable one to tackle all the important research problems in this area, requires knowledge of chemistry, physics, catalysis, materials science, electronics, nanotechnology, biochemistry, etc. This aspect is also reflected in the many different experimental techniques that are available to study electrocatalytic and electrochemical processes, which range from modifications of the classical spectroscopic techniques (Infrared, Raman, UV-VIS) to scanning probe microscopies (AFM, STM) to techniques based on electrical response (voltammetry, impedance spectroscopy, scanning electrochemical microscopy).

The purpose of this Training School was to bring together junior scientists from our COSTD36 Action to learn about the principles and possible applications of the various experimental techniques applicable to the study of the electrocatalytic systems. The Training School was held in the framework of a “Lorentz Workshop” at the Lorentz

Center of Leiden University. The format of the meeting was set up so as to actively involve participants in solving their own research questions. Student participants were asked to formulate a pertinent research question from their own research before the start of the Training School. After the specialist training lectures in the morning and early afternoon sessions, in the afternoon discussions, students presented their research questions in small groups of 6 students and two experts. Some of the research ideas generated in these sessions will hopefully lead to STSM (Short Term Scientific Missions) within the COSTD36 Action.

Apart from the organizers, the following specialists lectured at the workshop:

Prof. Dr. Olaf Magnussen, Kiel, Germany

Dr. Antonio Rodes, Alicante, Spain was replaced by Dr Paramaconi Rodriguez (Leiden University) due to illness

Dr. Bruno Pettinger, Berlin, Germany

Dr. Bernard Boukamp, Twente, NL

Prof. Dr. Helmut Baltruschat, Bonn, Germany

Prof. Dr. David Schiffrin, Liverpool, UK

Prof. Dr. Serge Lemay, Delft, NL

Prof. Dr. Julie Macpherson, Warwick UK

Prof. Dr. Robert Dryfe, Manchester, UK

Prof. Dr. Joost Frenken, Leiden, NL

Dr. Maarten van Brussel, Autolab, Utrecht, NL (Electrochemical instrumentation)

The special format of the meeting and the unique facilities of the Lorentz Center created an atmosphere of very lively discussions. The Training School provided a detailed background to some of the main techniques available to electrochemistry and surface science as well as an overview of some of the state-of-the-art research developments in electrochemical surface science. From the feedback provided by the students it is clear that the workshop was both educational and inspirational. We believe that most students will have gone home with many new ideas and insights.

The Workshop/Training School was supported financially by the Lorentz Center, COST, and the International Society of Electrochemistry.

FINAL PROGRAMME

Monday 24 November 2008

09:00 – 09:20 Registration and coffee at the Lorentz Center

Lorentz Room 201:

Chair: Marc Koper

09:20 – 09:30 Welcome by Lorentz Center Manager and Scientific Organizers

09:30 – 10:30 **David Schiffrin (Liverpool)**

Opening lecture: Some Fundamental Challenges in Electrocatalysis

10:30 – 11:00 Coffee break

Chair: Patrick Unwin

Session 1: Modulation Techniques in Electrochemistry

11:00 – 12:00 **Bernard Boukamp (Twente):** Electrochemical Impedance

Spectroscopy

12:00 – 12:30 **David J: Fermín (Bristol):** Potential Modulated Spectroscopy in

Electrochemical Systems

12:30 – 14:00 Lunch break restaurant Gorlaeus building

14:00 – 14:30 **Marc Koper (Leiden):** Nonlinear phenomena in electrochemical systems

(in room 201)

14:30 – 15:00 Groups 1 and 2 go to STM and UHV facilities;

Groups 3 and 4 go to the Electrochemistry Lab and Spectroscopy

facilities

GROUP DISCUSSIONS in Meeting rooms 331, 363, 201, 276

14:30 – 15:30 **Group discussions** between participants and experts / Tours of

research facilities

15:30 – 16:00	Coffee break
16:00 – 17:30	Group discussions between participants and experts / Tours of research facilities
17:30	Wine and Cheese Party

Tuesday 25 November 2008

Lorentz Room 201:

Chair: Alvaro Colina

Session 2: On-Line Mass Spectrometry and In-Situ Spectroscopy

09:00 – 10:00	Helmut Baltruschat (Bonn): Differential Electrochemical Mass Spectrometry
10:00 – 11:00	Antonio Rodes (Alicante): In situ infrared spectroscopy under electrochemical conditions. A comparison between the internal and external reflection approaches.
11:00 – 11:30	Coffee break

Chair: David Schiffrin

11:30 – 12:30	Bruno Pettinger (Berlin): Surface-Enhanced and Tip-Enhanced Raman Spectroscopy
12:30 – 14:00	Lunch break restaurant Gorlaeus building
14:00 – 15:00	Elizabeth Santos (Cordoba/Ulm): Non-linear Spectroscopy in Electrochemical Systems
15:00	<i>Free afternoon activities/excursion to Amsterdam</i>

Wednesday 26 November 2008

Lorentz Room 201:

Chair: Helmut Baltruschat

Session 3: High Resolution Scanning Probe Techniques

- 09:00 – 10:00 **Olaf Magnussen (Kiel):** Electrochemical Scanning Tunnelling
Microscopy
- 10:00 – 11:00 **Alex Yanson (Leiden):** Physics aspects of nano-electrochemistry
- 11:00 – 11:30 Coffee break
- 11:30 – 12:30 **Patrick Unwin (Warwick):** High Resolution Scanning
Electrochemical Microscopy
- 12:30 – 14:00 Lunch break restaurant Gorlaeus building
- 14:00 – 15:00 **Joost Frenken (Leiden):** Video-rate Scanning Tunnelling Microscopy
at ambient pressures
- 14:30 – 15:00 Groups 1 and 2 go to the Electrochemistry Lab and Spectroscopy
facilities;
Groups 3 and 4 go to STM and UHV facilities
- GROUP DISCUSSIONS** in Meeting rooms 331, 363, 201, 276
- 15:00 – 16:00 **Group discussions** between participants and experts / Tours of
research facilities
- 16:00 – 16:30 Coffee break
- 16:30 – 17:30 **Group discussions** between participants and experts / Tours of
research facilities

Thursday 27 November 2008

Lorentz Room 201:

Chair: Virginia Ruiz

Session 4: Electrodeposition and nanostructuring of surfaces

- 09:00 – 10:00 **Robert Dryfe (Manchester):** Electrochemical Generation of

Nanostructures at Liquid/Liquid interfaces

10:00 – 11:00 **Serge Lemay (Delft):** New tools for electrochemistry using nanofabrication

11:00 – 11:30 Coffee break

Chair: Dr. David J. Fermin

11:30 – 12:30 **Julie Macpherson (Warwick):** Electrochemical Nucleation at Single Wall Carbon Nanotubes

12:30 – 14:00 Lunch break restaurant Gorlaeus building

14:00 – 15:00 **Wolfgang Schmickler (Ulm)** Closing lecture: Theory of Electrocatalysis: the Path Ahead

GROUP DISCUSSIONS in Meeting rooms 331, 363, 201, 276:

15:00 – 16:30 **Group discussions** between participants and experts / Tours of research facilities

16:30 – 17:00 Bus transfer to Leiden City Center

(bus will wait at the side entrance of the Huygens/Oort Building)

17:00 – 19:00 Visit to the **Boerhaave Museum** followed by a **scientific excursion** through Leiden with Prof. Jos van den Broek

19:30 Workshop dinner at **De Regentenkamer**

(23:00hrs bus waits at Molen de Valk to bring you back to the Lorentz Center, the Bastion Hotel or to the Central Station)

Friday 28 November 2008

10:00 – 12:30 **Autolab tutorial** by Dr. Maarten van Brussel with coffee break

12:30 – 14:00 Lunch break restaurant Gorlaeus building

(Senior scientists from the COST working group have a separate WG meeting)