I. Brief Scientific Report

The aim of the present workshop was to discuss the status quo and to improve the precise characterisation of nanostructured surfaces by means of electron beam techniques. While novel techniques have been introduced for this purpose in the recent past, some of which are specifically developed to measure under ambient conditions to bridge the pressure gap, the full potential of conventional surface analysis techniques employing electron beams for nanometrology is presently not exploited. These techniques, such as (Hard) X-ray Photoelectron Spectroscopy (HAXPES), (Near Field Emission) Electron Microscopy, Auger Electron Spectroscopy and others, can in principle be used to calibrate dimensions on the nanoscale—in particular along the depth scale, which is difficult to achieve by any other means—by utilising the attenuation of electron beams. Some of the techniques mentioned above can in addition provide chemical information along with information on the dimensions of nanoobjects and therefore provide unique information which is very valuable for nanoscience and technology.

In spite of these developments, there is still a lack of quantitative understanding on the transport of electrons in nanostructures which prevents the potential of such techniques for nanostructure metrology to be fully harnessed. In order to improve upon this situation, several topics within this field are presently areas of active research. These include:

- Measurement and calculation of fundamental quantities needed for nanoscale calibration by means of electron beam attenuation
- Influence of nanomorphology and manybody effects on electron transport
- Optimisation of experimental approaches and quantitative data interpretation.

The aim of this specialized IUVSTA workshop was to bring together leading scientists as well as newcomers to the field that are involved in the different topics of relevance and to work out guidelines along which the field can advance most rapidly.

The scientific field and scope of the Workshop falls within the area of activity of the Applied Surface Science Divisions of IUVSTA. The duration of the workshop was 4 days. The scientific program consisted of invited lectures from selected worldwide recognized groups (see attached list of invited speakers and titles of their presentations). Panel discussions also took place to discuss recent results.
and future trends in nanostructure characterisation. Several sessions with contributed talks were held. One poster session for contributed papers was held on the evening of the first day of the workshop. The total number of participants was 50, originating from all continents (except Australia, see attached list of participants). The workshop venue was the Seminarhotel Castle Hernstein, a former Habsburg castle, surrounded by a big park (not open for public) near the tiny village of Hernstein, about 30 km from Vienna. This truly secluded location, guaranteed an event in which intensive interaction took place throughout the workshop during scientific as well as social events.

The scientific program of the meeting was developed by the Scientific and Program Committee, W. S. M. Werner (Austria), C. J. Powell (USA), M. Novak (Hungary). The Local Organizing Committee, with W.S.M. Werner, M. Marik (organisation logistics), C. Eisenmenger-Sittner (Finances), W. Hofer (IT), A. Bellisimo and M. Chudzicky (audio-visual facilities) was responsible for the local matters of organization and for ensuring appropriate conditions for the meeting. Financial questions like registration, contracts for accommodation, meals and transportation were handled by the Austrian Vacuum Society (ÖGV, Österreichische Gesellschaft für Vakuumtechnik, represented by Mrs. M. Marik). Details of the scientific program can also be found in the attached pages. In each session enough time was ensured for extended and intense scientific debates and discussions between the experts present. The sessions were moderated by selected experts of the particular topics.

Because of the dense technical program no social event was offered except the conference dinner in a nearby typical Austrian vineyard (“Heuriger”).
II. Financial Statement

It is certified that the financial support of 6.000.-€ provided by the IUVSTA for the *71st IUVSTA Workshop on Nanostructure Characterisation by Electron Beam Techniques*, was fully used to cover fixed costs, namely the cost of invited Reviewers and other international experts in the field, as specified in detail in the list below.

Prof. Lijequist David  
Dr. Cohen Hagai  
Dr. Collex Christian  
Dr. Baer Donald Ray  
Prof. Castner David G.  
Prof. Garcia-Molina Rafa  
Dr. Salvat-Pujol Francesc  
Prof. Ding Zejun  
Dr. Kover Laszlo  
Dr. Drube Wolfgang  
Prof. Fadley Charles  
Dr. Shard Alexander  
Dr. Gianluca Di Fillipo  
Dr. Gervasoni Juana  
Dr Zinedine Chaoui

Total support : 6050 €

Vienna, july 29, 2013.
Dr. Wolfgang Werner, Chairman.

*Enclosures: List of invited reviewers, Scientific program and List of Participants*
## Invited Speakers

<table>
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<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Topic</th>
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<tr>
<td>Hagai Cohen</td>
<td>IL</td>
<td>Near and far-field spectroscopy at the nano-scale using focused electron beams</td>
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<td>Christian Colliex</td>
<td>F</td>
<td>Mapping the surface structural and electronic properties of individual nanoparticles with the tiny beam of a Scanning Transmission Electron Microscope (STEM)</td>
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<td>Don Baer</td>
<td>US</td>
<td>Characterizing Nanoparticles for Environmental and Biological Applications</td>
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<tr>
<td>Dave Castner</td>
<td>US</td>
<td>Nanoparticles in Biomedical Applications: Characterization Challenges, Opportunities and Recent Advances</td>
</tr>
<tr>
<td>Shigeo Tanuma</td>
<td>JP</td>
<td>Calculations of Electron Inelastic Mean Free Paths in Solids Over the 50 eV to 30 keV Range with Relativistic Full Penn Algorithm</td>
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<tr>
<td>Rafael Garcia-Molina</td>
<td>ES</td>
<td>Inelastic scattering of proton beams in biological materials</td>
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<tr>
<td>Cesc Salvat-Pujol</td>
<td>D</td>
<td>Surface excitations in electron spectroscopy</td>
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<tr>
<td>Zhe-Jun Ding</td>
<td>CN</td>
<td>Roughness effect on electron spectrum</td>
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<tr>
<td>Cesc Salvat Gavalda</td>
<td>ES</td>
<td>Inelastic collisions of charged particles: PWBA and asymptotic Bethe formulas</td>
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<td>Laszlo Kover</td>
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<td>Intrinsic and surface excitations in XPS/HAXPES</td>
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<td>Wolfgang Drube</td>
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<td>Electronic characterization of nano-structured materials by HAXPES</td>
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<tr>
<td>Chuck Fadley</td>
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<td>Characterization of Nanostructures with Hard X-Ray Photoemission</td>
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<td>Mihaly Novak</td>
<td>H</td>
<td>Monte Carlo simulation of supersurface electron scattering effects</td>
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<tr>
<td>Alex Shard</td>
<td>UK</td>
<td>Practical XPS Analysis of Nanoparticles</td>
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<tr>
<td>Hideki Yoshikawa</td>
<td>JP</td>
<td>Energy loss functions and IMFPs derived by factor analysis of reflection electron energy loss spectra</td>
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<tr>
<td>Kyung-Joong Kim</td>
<td>KR</td>
<td>Traceable Thickness Measurement of nm Oxide Films by XPS</td>
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<tr>
<td>Alex Jablonski</td>
<td>PL</td>
<td>Quantification of XPS Analysis of Stratified Samples</td>
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<tr>
<td>David Liljequist</td>
<td>S</td>
<td>Model studies of the validity of trajectory methods for calculating very low energy (&lt;100 eV) electron transport in condensed media</td>
</tr>
<tr>
<td>Maurizio Dapor</td>
<td>I</td>
<td>Monte Carlo simulation of secondary electron emission in the low-energy domain</td>
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</table>
Programme 71st IUVSTA Workshop: Nanocharacterisation by Electron Beam Techniques

Tuesday June 25

8:30-9:00 Opening Address

Session 1: Fundamentals: Inelastic scattering
Session Chair: David Liljequist

9:00-9:30 Inelastic scattering of proton beams in biological materials
Rafael Garcia-Molina Universidad de Murcia, Murcia, Spain

9:30-10:00 Calculations of Electron Inelastic Mean Free Paths in Solids Over the 50 eV to 30 keV Range with Relativistic Full Penn Algorithm
Shigeo Tanuma National Institute for Materials Science, Tsukuba, Japan

10:00-10:30 Coffee-break

Session 2: Fundamentals: Inelastic scattering
Session Chair: Juana Gervasoni

10:30-11:00 Surface excitations in electron spectroscopy
Cesc Salvat-Pujol J.W. Goethe-Universität, Frankfurt/Main, Germany

11:00-11:30 Monte Carlo simulation of supersurface electron scattering effects
Mihaly Novak Institute of Nuclear Research of the Hungarian Academy of Sciences ATOMKI Debrecen, Hungary

12:00-14:00 Lunch

Session 3: Applications of models for electron scattering
Session Chair: John Villarubia

14:00-14:30 Electron Scattering with Rough Surfaces in Surface Electron Spectroscopy
Zhe-Jun Ding University of Science and Technology of China, Hefei, China

14:30-15:00 Monte Carlo simulation of secondary electron emission in the low-energy domain. Application to the microelectronics.
Maurizio Dapor Fondazione Bruno Kessler, Trento, Italy

15:30-16:00 Coffee-break

Session 4: Secondary (slow) Electrons
Session Chair: Cedric Powell

16:00-16:15 SEM Simulation Program for dimensional Nano-Metrology
Carl Georg Frase Physikalisch-Technische Bundesanstalt PTB) Braunschweig, Braun- schweig, Germany

16:15-16:30 Modeling Scanning Electron Microscope Measurements with Charging
John Villarrubia National Institute of Standards and Technology, Gaithersburg, USA

16:30-16:45 Transmission Mode in the Scanning Electron Microscope at Very Low Energies
Ivana Müllerova Institute of Scientific Instruments of the ASCR, Brno, Czech Republic

16:45-17:00 Plasmon resonant (e,2e) spectroscopy
Gianluca DiFilippo Dipartimento di Scienze and CNISM, Università Roma Tre, Rome, Italy

17:00-17:15 Near Field-Emission Scanning Electron Microscopy with Energy Analysis
Daniele Andrea Zarini Laboratory for Solid State Physics ETH Zürich, Zürich, Switzerland

17:15-17:30 Local crystallographic information in Kikuchi patterns of backscattered electrons: experiments and simulations
Aimo Winkelmann Max-Planck-Institute of Microstructure Physics, Weinberg, Germany
Poster Session

17:30-19:00

Electron multiple inelastic scattering analysis in bulk carbon film
Alon Givon Department of Nuclear Engineering, Ben-Gurion University of the Negev, Israel

Utilizing Artificial Neural Networks for the Automation of Auger Spectra Analysis
Besnik Poniku Institute of Metals and Technology, Ljubljana, Slovenia

Influence of Rolling Technology Process on Electron Transport in steels
Evgeny Alekseevitch Deulin Bauman Moscow State Technical University, Moscow, Russia

Effects of sudden photo electron-hole pair creation on the induced surface plasmon excitations in cylindrical nanorods
Juana L. Gervasoni Bariloche Atomic Center and Instituto Balseiro, Bariloche, Argentina

Comparison of calculated and experimental spectra of plasmon excitation in single-walled carbon nanotubes probed using charged particles
Juana L. Gervasoni Bariloche Atomic Center and Instituto Balseiro, Bariloche, Argentina

Plasmon potential induced by an external charged particle traversing a solid surface in incoming and outgoing trajectories
Juana L. Gervasoni Bariloche Atomic Center and Instituto Balseiro, Bariloche, Argentina

Plasmon-enhanced secondary electron emission from copper phthalocyanine deposited on
Gianluca DiFillipo Dipartimento di Scienze and CNISM, Universit Roma Tre, Rome, Italy

Multi-walled carbon nanotubes irradiated by proton beams: An energy loss study
Isabel Abril Departament de Fsica Aplicada, Universitat dAlacant, Alacant, Spain

Signal Intensity Distribution in PAR-XPS from Rough Surfaces
Josef Brenner AC2T research GmbH, Wr. Neustadt, Austria

Electron inelastic mean free paths for cerium dioxide
Marcin Holdynski Mazovia Centre for Surface Analysis, Institute of Physical Chemistry, Polish Academy of Sciences, Warszawa, Poland

ARXPS - simulation and data analysis
Steffen Oswald IFW Dresden, Dresden, Germany

ARXPS on Surface Pre-Treatments for LiNbO3 SAW substrate
Uwe Vogel IFW Dresden-Institute for Complex Materials and TU Dresden, Institute of Materials Science, Dresden, Germany

Alessandra Bellissimo, Wolfgang S.M. Werner, Francesc Salvat-Pujol, Rahila Khalid, Mihaly Novak and Gianni Stefani Institut für Angewandte Physik, Vienna University of Technology, Wiedner Hauptstraße 8-10/134, Vienna, Austria

Definition of arbitrary surface nanomorphologies in SESSA
Maksymilian Chudzicki, Wolfgang S.M. Werner, Werner Smekal and Cedric Powell Institut für Angewandte Physik, Vienna University of Technology, Wiedner Hauptstraße 8-10/134, Vienna, Austria
Wednesday June 26
Session 5: Transport Models for Nanostructures
Session Chair: Mihaly Novak

08:30-09:00  Inelastic collisions of charged particles: PWBA and asymptotic Bethe formulas
Cesc Salvat Gavalda Universitat de Barcelona, Barcelona, Spain

09:00-09:30  Model studies of the validity of trajectory methods for calculating very low energy (<100 eV) electron transport in condensed media
David Liljequist Department of Physics, Stockholm University, Stockholm, Sweden

10:00-10:30  Coffee-break

Session 6: Electron Microscopy and EELS
Session Chair: Ilona Müllerova

10:30-11:00  Mapping the surface structural and electronic properties of individual nanoparticles with the tiny beam of a Scanning Transmission Electron Microscope (STEM)
Christian Colliex Université Paris Sud, Orsay, France

11:00-11:30  Near and far-field spectroscopy at the nano-scale using focused electron beams
Hagai Cohen Weizmann Institute of Science, Rehovot, Israel

12:00-14:00  Lunch

Session 7: XPS on Nanostructures
Session Chair: Dave Castner

14:00-14:30  Practical XPS Analysis of Nanoparticles
Alexander G. Shard National Physical Laboratory, Teddington, UK

14:30-15:00  Traceable Thickness Measurement of nm Oxide Films by XPS
Kyung-Joong Kim Korea Research Institute of Standards and Science, Yuseong-gu, Rep. of Korea

15:30-16:00  Coffee-break

Session 8: Contributed Papers and Panel discussion
Session Chair: Don Baer

16:00-16:15  Sample-Morphology Effects on XPS Peak Intensities: Estimation of Detection Limits for Buried Thin Films
Cedric J Powell Materials Measurement Science Division, National Institute of Standards and Technology, Gaithersburg, USA

16:15-16:30  Experimental Effective Attenuation Length for applications in Hard X-ray photoelectron spectroscopy
German R. Castro SpLine Spanish CRG BM25 Beamline at the ESRF, Grenoble Cedex, France and Instituto de Ciencia de Materiales de Madrid-ICMM/CSIC, Madrid, Spain
Nanostructure Characterisation by Electron Beam Techniques

Thursday June 27
Session 9: HAXPES
Session Chair: Laszlo Kőver

08:30-09:00
Characterization of Nanostructures with Hard X-Ray Photoemission
Chuck Fadley Department of Physics University of California Davis, USA

09:00-09:30
Electronic characterization of nano-structured materials by HAXPES
Wolfgang Drube Deutsches Elektronen-Synchrotron, Hamburg Germany

10:00-10:30
Coffee-break

Session 10: XPS on Nanostructures
Session Chair: Alex Shard

10:30-11:00
Intrinsic and surface excitations in XPS/HAXPES
Laszlo Kover Institute of Nuclear Research of the Hungarian Academy of Sciences ATOMKI Debrecen, Hungary

11:00-11:30
Quantification of XPS Analysis of Stratified Samples
Alex Jablonski Polish academy of sciences, Warsaw, Poland

12:00-14:00
Lunch

Session 11: Optical Data and Instrumental developments
Session Chair: Maurizio Dapor

14:00-14:30
Energy loss functions and IMFPs derived by factor analysis of reflection electron energy loss spectra
Hideki Yoshikawa National Institute for Materials Science, Tsukuba, Japan

14:30-15:00
PHOIBOS 225 HV: High energy electron spectrometers with wide acceptance angle pre-lens
Thorsten U. Kampen SPECS Surface Nano Analysis, Berlin, Germany

15:30-16:00
Coffee-break

Session 12: XPS and Applications
Session Chair: Chuck Fadley

16:00-16:15
Combined nano-AES and EDS characterization of materials
Muriel Bouttemy Institut Lavoisier, Université de Versailles St-Quentin, Versailles cedex, France.

16:15-16:30
Electron beam induced changes in Auger electron spectra for Lithium ion battery materials
Martin Hoffmann IFW Dresden and TU Dresden, Dresden, Germany

16:30-16:45
Electron scattering in graphene/copper system
Petr Jiricek Institute of Physics, v. v. i., Academy of Sciences of the Czech Republic, Prague, Czech Republic,

16:45-17:00
Surface characterization of ZnO and Ag loaded metal oxide nanotubes using spectroscopic techniques
Agata Roguska Institute of Physical Chemistry, Polish Academy of Sciences, Warsaw, Poland

17:00-17:15
Monte Carlo simulations of low energy electron in nanostructures
Zine El Abidine Chaoai Laboratory of Optoelectronics and Compounds. University of Setif1, Algeria
Friday June 28
Session 13: Practical Aspects
Session Chair: Hagai Cohen

08:30-09:00
Characterizing Nanoparticles for Environmental and Biological Applications
Don Baer EMSL Pacific Northwest National Laboratory, Richland, WA, USA

09:00-09:30
Nanoparticles in Biomedical Applications: Characterization Challenges, Opportunities and Recent Advances
Dave Castner University of Washington Seattle, USA

10:00-10:30
Coffee-break

10:30-12:00
Session 14: Panel Discussion
Moderators: Don Baer and Dave Castner

Workshop Closing

12:00-14:00
Lunch
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<tr>
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### List of Participants

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