

71st IUVESTA Workshop
on
Characterisation of Nanostructures by means of Electron Beam
Techniques

June 24-28, 2013, Castle Hernstein, Austria

Sponsored by the Applied Surface Science Division of IUVESTA

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 IUVESTA 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 IUVESTA. 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. Bellissimo 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	400
Dr. Cohen Hagai	400
Dr. Collex Christian	400
Dr. Baer Donald Ray	400
Prof. Castner David G.	400
Prof. Garcia-Molina Rafa	700
Dr. Salvat-Pujol Francesc	400
Prof. Ding Zejun	400
Dr. Kover Laszlo	400
Dr. Drube Wolfgang	400
Prof. Fadley Charles	400
Dr. Shard Alexander	400
Dr. Gianluca Di Fillipo	300
Dr. Gervasoni Juana	300
Dr Zinedine Chaoui	350
Total support :	6050 €

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

Enclosures: List of invited reviewers, Scientific program and List of Participants

Invited Speakers

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

Programme 71st IUVESTA Workshop: Nanocharacterisation by Electron Beam Techniques

Tuesday June 25

8:30-9:00	Opening Address
	Session 1: Fundamentals: Inelastic scattering Session Chair: David Lilljequist
9:00-9:30	Inelastic scattering of proton beams in biological materials <i>Rafael Garcia-Molina</i> 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 <i>Shigeo Tanuma</i> 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 <i>Cesc Salvat-Pujol</i> J.W.Goethe-Universitt, Frankfurt/Main, Germany
11:00-11:30	Monte Carlo simulation of supersurface electron scattering effects <i>Mihaly Novak</i> 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 <i>Zhe-Jun Ding</i> 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. <i>Maurizio Dapor</i> 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 <i>Carl Georg Frase</i> Physikalisch-Technische Bundesanstalt PTB) Braunschweig, Braunschweig, Germany
16:15-16:30	Modeling Scanning Electron Microscope Measurements with Charging <i>John Villarrubia</i> National Institute of Standards and Technology, Gaithersburg, USA
16:30-16:45	Transmission Mode in the Scanning Electron Microscope at Very Low Energies <i>Ilona Müllerova</i> Institute of Scientific Instruments of the ASCR, Brno, Czech Republic
16:45-17:00	Plasmon resonant (e,2e) spectroscopy <i>Gianluca DiFillipo</i> Dipartimento di Scienze and CNISM, Universit Roma Tre, Rome, Italy
17:00-17:15	Near Field-Emission Scanning Electron Microscopy with Energy Analysis <i>Danilo Andrea Zanin</i> 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 <i>Aimo Winkelmann</i> Max-Planck-Institute of Microstructure Physics, Weinberg, Germany

17:30-19:00

Poster Session

Tuesday, June 25

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 Moscov 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 Física Aplicada, Universitat d'Alacant, 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

Secondary-Electron Electron-Energy-Loss Coincidence Measurements on Polycrystalline Aluminum

Alessandra Bellissimo, Wolfgang S.M. Werner, Francesc Salvat-Pujol, Rahila Khalid, Mihaly Novak and Gianni Stefani Institut für Angewandte Physik, Vienna University of Technology, Wiednerhauptstraße 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, Wiednerhauptstraße 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 Universit 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

Thursday June 27

Session 9: HAXPES

Session Chair: Laszlo Köver

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, Universit 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 Chaoui 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

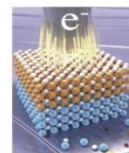
Moderators: Don Baer and Dave Castner

Workshop Closing

12:00-14:00 Lunch



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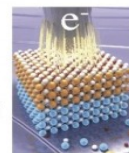


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