Vacuum Science and Technology Division
Fachverband Vakuumphysik und Vakuumtechnik (VA)

Wolfgang Jitschin
Fachbereich MNI
Fachhochschule Giessen-Friedberg
Wiesenstrasse 14
35390 Giessen
jitschin@vakuumlabor.de

Gerhard Voss
Oerlikon Leybold Vacuum GmbH
Bonner Strasse 498
50968 Köln
gerhard.voss@oerlikon.com

Homepage des Fachverbandes: http://www.vakuumphysik.de

Overview of Invited Talks and Sessions

(lecture room HSZ 101)

Invited Talks

VA 1.1	Mon	10:30–11:10	HSZ 101	**ITER, the next step to clean energy by fusion - Size matters** — •Christian Day
VA 3.1	Mon	14:00–14:45	HSZ 101	**Thin Film Silicon Solar Cells and Modules: From R&D Lab Developments to Large-area Production Tools** — •Ulrich Kroll et al.
VA 3.2	Mon	14:45–15:30	HSZ 101	**Singulus Bluline II BD50 Enabling the Blu-ray Future with Unlimited Space** — •Stephan Hotz
VA 5.1	Wed	14:00–14:45	HSZ 02	**Engineering surfaces, interfaces and structural phases to tailor magnetic properties** — •Jürgen Fassbender

Sessions

VA 1.1–1.4	Mon	10:30–12:10	HSZ 101	**ITER - The new international fusion reactor**
VA 2.1–2.2	Mon	12:15–12:55	HSZ 101	**Ultra-high vacuum UHV**
VA 3.1–3.2	Mon	14:00–15:30	HSZ 101	**Challenging vacuum applications**
VA 4.1–4.2	Mon	15:30–16:10	HSZ 101	**Diffusion, magnetic thin films**
VA 5.1–5.1	Wed	14:00–14:45	HSZ 02	**Gaede Prize Talk**

Annual Meeting of the Vacuum Science and Technology Division

Monday, 23 March 2009 16:20–17:00 Room HSZ 101

- Bericht des Fachverband-Vorsitzenden
- Perspektiven des Fachverbandes
- Verschiedenes

VA 1: ITER - The new international fusion reactor

Time: Monday 10:30–12:10 Location: HSZ 101

Invited Talk VA 1.1 Mon 10:30 HSZ 101

ITER, the next step to clean energy by fusion - Size matters — •Christian Day — Forschungszentrum Karlsruhe, Institut für Technische Physik, Postfach 3640, 76021 Karlsruhe

Fusion is the energy source of our sun which keeps our earth alive. Fusion research is aimed at using this energy source with abundant fuel resources to produce electricity in a safe, environmentally benign way without CO2-emission, to meet the needs of a growing world population.

ITER is a joint research and development project that aims to demonstrate the scientific and technical feasibility of thermonuclear fusion power. With seven parties participating in the project (European Union, Japan, China, Korea, the Russian Federation, India, and the USA), ITER constitutes one of the largest international scientific projects of its kind and brings together countries representing over one-half of the world's population. ITER will be built at Cadarache in the South of France.

The ITER mission is the next large step to develop nuclear fusion from the plasma physics level towards a technology with the potential and technical availability to act as future energy source. Hence, engineering is the core element of the ITER project. ITER will generate some 500 MW of fusion power, with a tenfold energy output/input ratio under conditions similar to those expected in an electricity-generating fusion power plant. The talk will present the ITER project, address major technical challenges and outline the impressive ITER vacuum systems.

VA 1.2 Mon 11:10 HSZ 101

Strömungsberechnung in großen Vakuumsystemen — •Volker Hauer und Christian Day — Institut für Technische Physik, Forschungszentrum Karlsruhe GmbH, Postfach 3640, 76021 Karlsruhe,

Die Berechnung von Massenströmen und Leitwerten in großen Vakuumsystemen ist ohne die Verwendung spezialisierter Software kaum möglich. Neben der großen Anzahl der Bauelemente können Asymmetrien und das gleichzeitige Auftreten unterschiedlicher Strömungsbereiche die Berechnung erschweren. Am Beispiel des ITER-Torusvakuumsystems unter Verwendung des Simulationsprogramms ITERVAC soll die Berechnung eines großen Vakuumsystems demonstriert werden.

Die Software ITERVAC simuliert ein Vakuumsystem als ein Netz von Kanälen. Jeder Kanal hat eine definierte Form, Querschnittsfläche und Länge. ITERVAC berechnet auf Basis der geometrischen Daten, der Gasart, der Temperatur und der Druckdifferenz den Massenstrom in jedem einzelnen Kanal. In einem weiteren Simulationsschritt können die Drücke am Ein- und Ausgang der einzelnen Kanäle bestimmt werden. Für das ITER-Torusvakuumsystem wurde ein Modell erstellt und für verschiedene Gase die Massenströme und Drücke ermittelt.

Parallel zu den Berechnungen wurde die verwendete Simulationssoftware validiert. Dazu wurden Messungen an langen und kurzen Kanälen unterschiedlicher Form durchgeführt und mit den Simulationsergebnissen verglichen. Die erreichte Übereinstimmung liegt innerhalb der Messungenauigkeiten.

VA 1.3 Mon 11:30 HSZ 101

The Novel Cryopump for the Neutral Beam Injection Systems of ITER — •Stefan Hanke, Christian Day, and Matthias Dremel — Institut für Technische Physik, Forschungszentrum Karlsruhe GmbH, Postfach 3640, 76021 Karlsruhe

The Neutral Beam Injection Systems (NBI) for ITER induce extraordinary high demands on the supporting vacuum system. The Beam Line Components of the NBI are considerable sources of gas and thermal radiation.

A cryopump design was developed to fulfil the two main operational tasks: a pumping speed of several 10^3 m^3/s and high gas loads of protium and deuterium to be pumped. The design was driven by two competing requirements: The high thermal heat loads ask for a closed pump, the need of a high pumping speed ask for an open structure. To combine both objectives in an optimized geometry the Test Particle Monte Carlo code MOVAK 3D was used.

The talk will give an overview of the NBI, the implications for the vacuum system, the approaches to solve and optimize various aspects and the resulting features of the actual cryopump design.

VA 1.4 Mon 11:50 HSZ 101

ProVac3D and Application to the Neutral Beam Injection System of ITER — •Xueli Luo, Christian Day, and Matthias Dremel — Institut für Technische Physik, Forschungszentrum Karlsruhe GmbH, Postfach 3640, 76021 Karlsruhe

We have developed ProVac3D (3D density Profiles in Vacuum systems), a Monte Carlo simulation code, to calculate gas dynamics and the density profiles in a complex vacuum system characterized by distributed gas sources and pumps. The Neutral Beam Injection System of ITER is a good example of such a system, for which Forschungszentrum Karlsruhe is responsible to design the state-of-the-art cryogenic pump. By using ProVac3D, we can intensively study volumes of interest inside NBI and get the information about the pumping speed in order to provide the required density profile along the beamline. The advantage of ProVac3D is that it is flexible with modular structures and very fast to achieve precise statistics by large simulation numbers even with a current desktop computer. To extend ProVac3D beyond the free molecular regime, the collision of the probe molecule with the gas background has been included. We are going to present some preliminary results as well.

VA 2: Ultra-high vacuum UHV

Time: Monday 12:15–12:55 Location: HSZ 101

VA 2.1 Mon 12:15 HSZ 101

New Methods to Achieve UHV/XHV with Refrigerator Cooled Cryopumps — •Dieter Müller — Oerlikon Leybold Vacuum GmbH, Köln, Deutschland

Besides beiing absolutely hydrocarbon-free, refrigerator-cooled cryopumps have unmatched pumping efficiency for water vapor among all high vacuum pumps. Thus we recommend them to use in UHV/XHV systems even during bakeout. The thermal balance of cryopumps in vacuum systems during baking is discussed and modifications of commercial pumps to withstand the heat flux into the pump are discussed. Practical results are shown reaching XHV pressures below 1E-12 mbar.

VA 2.2 Mon 12:35 HSZ 101

AFM, STM and Atom Probe study on vacuum fired 316 LN stainless steel — Paul Frank[1], Lars Westerberg[2], and •Manfred Leisch[1] — [1]Institut für Festkörperphysik, TU Graz, 8010 Graz, Austria — [2]Department of Physics, Uppsala University, SE 751 21 Uppsala, Sweden

Stainless steel is one of the most used construction materials in vacuum technology. In order to reduce the outgassing of hydrogen a high temperature treatment (vacuum firing) is a common used method especially in XHV applications. Since the outgassing process is strongly related to surface morphology the surface of grade 316 LN stainless steel, after low temperature bake-out process and vacuum annealing, has been studied by atomic force microscopy (AFM) and scanning tunnelling microscopy (STM). The local elemental composition on the surface before and after thermal treatment has been investigated by atom probe (AP) depth profiling measurements. After vacuum annealing AFM and STM show distinct changes in the surface structure and topology. Compared to previous studies on grade 304 L stainless steel recrystallisation and surface reconstruction is less pronounced on the 316 LN material. AP depth profiling analyses result in nickel enrichment on the surface. Since hydrogen recombination is almost controlled by surface structure and composition the experimental results will be discussed with respect to the influence on the outgassing behaviour.

(Work supported by Zukunftsfonds des Landes Steiermark P 119).

VA 3: Challenging vacuum applications

Time: Monday 14:00–15:30 Location: HSZ 101

Invited Talk VA 3.1 Mon 14:00 HSZ 101

Thin Film Silicon Solar Cells and Modules: From R&D Lab Developments to Large-area Production Tools — •Ulrich Kroll et al. — Oerlikon Solar-Lab SA, Rue du Puits-Godet 12a, CH-2000 Neuchâtel

Up-scaling of thin film silicon solar cells to industrial commercial products of 1 m2 module area is a highly challenging task. Hereby, the transfer of high efficiency device results obtained in small area research-type equipments to large area high performance R&D and high productivity mass fabrication equipment are important issues needed to be solved. Especially the PECVD (Plasma Enhanced Chemical Vapor Deposition) equipment in the thin film production line is one of the most important key elements to bring the module efficiency up and to reduce manufacturing costs.

In a first step, deposition processes are developed and optimized in smaller R&D KAI systems. These process parameters are then transferred to industrial size reactors of 1.4 m2. Following this strategy we achieved recently amorphous silicon p-i-n single-junction and Micromorph (amorphous/ microcrystalline silicon) tandem junction 1.4 m2 R&D solar modules with initial aperture module efficiencies of 9.63% respectively of 9.6 %. These remarkable efficiencies clearly demonstrate the high potential of our PECVD systems.

Based on these results, Oerlikon Solar as an equipment manufacturer is installing production facilities for amorphous silicon and Micromorph PV modules in the range well above several 100 MW capacities for all its customers worldwide.

Invited Talk VA 3.2 Mon 14:45 HSZ 101

Singulus Bluline II BD50 Enabling the Blu-ray Future with Unlimited Space — •Stephan Hotz — Singulus Technologies AG, Hanauer Landstrasse 103, 63796 Kahl am Main

BLULINE II BD50 Enabling the Blu-ray Future with Unlimited Space Hollywood Studios want to take advantage of the enormous storage capacity of a BD50 disc in order to deliver an unprecedented video and audio experience to the home consumer. For this reason, the availability of 50GB dual layer Blu-ray discs is a clear must for pre-recorded formats. The Blu-ray format has definitively established itself as the new standard in the market. High-definition television, HDTV (HD Ready and Full HD), combined with the Blu-ray video format, is the new technology of the media sector. The market introduction of the 50 GB dual layer Blu-ray disc was a show-stopper for the entertainment industry. The high storage capacity of the format enables optimum audio and video high-definition quality and also offers the ability to store bonus material such as additional trailers, interviews with directors and stars as well as BD-Java-based applications, enabling viewers to enjoy an interactive movie experience never before possible. SINGULUS' experience in the field of Blu-ray goes back to its early, exclusive partnership with the format developer Sony in 2005. SINGULUS has also already installed several Blu-ray production lines at the biggest independent disc manufacturers. The SINGULUS Blu-ray Disc production system BLULINE II is designed for the economical production of Blu-ray Discs (BD ROM Single Layer and Dual Layer (BD ROM SL/DL)) according to the specifications issued by the BDA.

VA 4: Diffusion, magnetic thin films

Time: Monday 15:30–16:10 Location: HSZ 101

VA 4.1 Mon 15:30 HSZ 101

Simulation of Diffusion Processes in Rarefied Gases - A Hybrid Approach — David Sinz[1,2], •Jens Harting[1], Franz Keller[2], and Ulrich Nieken[2] — [1]Institut für Computerphysik, Pfaffenwaldring 27, 70569 Stuttgart — [2]Institut für Chemische Verfahrenstechnik, Böblinger Str. 72, 70199 Stuttgart

We simulate diffusion-convection problems in rarefied gases in order to predict the diffusive spreading of low concentrated contaminants in a stream of purge gas.

The proposed simulation method is a hybrid approach combining the lattice Boltzmann method (LBM) and a simplified molecular dynamics (MD) approach. Here, the flow field of the purge gas is simulated using the LBM and the behaviour of the contaminants is described by a MD approach neglecting the interaction of the particles with each other and the gas. The influence of the purge gas on the contaminants is modeled by central collisions with pseudo particles, where the collision frequency dependents on the mean free path of the MD particles. The velocity of the pseudo particles is determined by the predicted flow field of the purge gas as well as thermal fluctuations.

Our approach requires substantially less computing time than a regular MD approach and allows the simulation of systems of technically interesting dimensions. The method is evaluated by comparing simulation results to analytical solutions for simple test cases as well as to experimental data for a more complex case both with acceptable agreement.

VA 4.2 Mon 15:50 HSZ 101

Spin-resolved HAXPES technique for the investigation of new spintronic materials. — •Gregory Stryganyuk[1], Siham Quardi[1], Xeniya Kozina[1], Andrei Gloskovskii[1], Gerhard H. Fecher[1], Claudia Felser[1], Michaela Hahn[2], Gerd Schönhense[2], Masafumi Yamamoto[3], Koichiro Inomata[4], Eiji Ikenaga[5], and Keisuke Kobayashi[5] — [1]Institute of Inorganic and Analytical Chemistry, Johannes Gutenberg - University, 55128 Mainz — [2]Institute of Physics, Johannes Gutenberg - University, 55128 Mainz — [3]Graduate School of Information Science and Technology, Hokkaido University, Sapporo, Japan — [4]National Institute for Materials Science, Tsukuba 305-0047, Japan — [5]SPring-8 JASRI, Hyogo, 679-5198, Japan

The elaboration of innovative spintronic devices implies the employment of spin dependent electronic properties of magnetic materials. Growing interest in search and development of promising spintronic materials requires spin-resolved studies. This work reports on the development of spin polarized high resolution hard X-ray photoemission spectroscopy (SPIN HAXPES) at SPring-8. Hard X-ray excitation provides the possibility to study a whole spintronic multilayer device due to the large inelastic mean free path of the photoelectrons at high kinetic energies. The implementation of SPIN HAXPES using a SCIENTA R4000 analyzer equipped with SPLEED detector is discussed. The installation of a phase retarder at BL47XU beamline is considered for studies of magnetic circular dichroism in the core level photoemission and spin-resolved experiments. This work is funded by JST-DfG (Project FE 633/6-1).

VA 5: Gaede Prize Talk

Time: Wednesday 14:00–14:45 Location: HSZ 02

Invited Talk VA 5.1 Wed 14:00 HSZ 02

Engineering surfaces, interfaces and structural phases to tailor magnetic properties — •Jürgen Fassbender — Institute of Ion Beam Physics and Materials Research, Forschungszentrum Dresden-Rossendorf e. V., P. O. Box 51 01 19, D-01314 Dresden — Träger des Gaede-Preises

Surfaces and interfaces play an important role in order to determine the overall properties of ultrathin magnetic films and multilayers. In particular, the morphology and roughness of the surface and the sharpness of mutual interfaces between magnetic and non-magnetic thin films are crucial. All these parameters are easily accessible by means of ion irradiation [1,2], ion implantation [2,3] and ion erosion approaches [4]. Also structural phase transitions can be accompanied by magnetic ones [5] which allow the creation of nanomagnets in the sub-100 nm regime [6]. In this talk I am going to present a survey of ion beam modifications of magnetic materials with special emphasis on the basic phenomena including some technological applications. Supported by DFG FA 314/3-1, FA 314/6-1 and FA 314/7-1.

[1] J. Fassbender, D. Ravelosona, Y. Samson, J. Phys. D 37, R179 (2004). [2] J. Fassbender, J. McCord, J. Magn. Magn. Mat. 320, 579 (2008). [3] J. McCord, L. Schultz, J. Fassbender, Adv. Mater. 20, 2090 (2008). [4] M. O. Liedke et al., Phys. Rev. B 75, 220407(R) (2007). [5] J. Fassbender et al., Phys. Rev. B 77, 174413 (2008). [6] E. Menendez et al., Small, in press.