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

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Overview of Invited Talks and Sessions

(Lecture room H25)

Invited Talks

VA 1.1	Mon	9:00– 9:45	H25	**The stellarator Wendelstein 7-X: vacuum technology, vacuum leak search, system commissioning** — •Juergen Baldzuhn, Hans-Stephan Bosch, Heinz Grote, Olaf Volzke, Lutz Wegener
VA 2.1	Mon	10:30–11:15	H25	**Novel routes in vacuum metrology at PTB and beyond** — •Stephan Putzke, Karl Jousten
VA 3.1	Mon	14:00–14:45	H25	**Development of an Absolute Valve for ITERs Neutral Beam Injection** — •Martin Greuter, Verena Saissrainer

Sessions

VA 1.1–1.2	Mon	9:00–10:15	H25	**Large Vacuum Systems**
VA 2.1–2.2	Mon	10:30–11:45	H25	**Vacuum Physics**
VA 3.1–3.3	Mon	14:00–15:45	H25	**Vacuum Generation & Measurement**

Annual General Meeting of the Vacuum Science and Technology Division

Monday 16:00–16:30 H25

VA 1: Large Vacuum Systems

Time: Monday 9:00–10:15 Location: H25

Invited Talk VA 1.1 Mon 9:00 H25

The stellarator Wendelstein 7-X: vacuum technology, vacuum leak search, system commissioning — •Juergen Baldzuhn, Hans-Stephan Bosch, Heinz Grote, Olaf Volzke, and Lutz Wegener — Max-Planck Institute for Plasma Physics, 17491 Greifswald, Germany

The new stellarator Wendelstein 7-X (W 7-X) is now (Nov. 2015) almost ready to go into plasma operation. This experimental plasma device is built to exploit the potential of nuclear fusion in a toroidal arrangement. The plasma will be situated inside a non-magnetic stainless steel vessel, surrounded by seventy superconducting and fifteen normal conducting coils. In order to guarantee reliable plasma operation, the vacuum pressure inside the plasma vessel must be in the range of 10-8 mbar. Mechanical pumps are available today for the evacuation of the vessels. In the future they will be complemented by cryo-pumps. A description of the stellarator W 7-X will be given. Emphasis is on the vacuum systems and the particular requirements for the technical vacuum production in a fusion device. Some particular pumping and vacuum systems will be delineated, as they are used for high power neutral particle injection systems in a fusion device. They highlight the peculiar requirements that are imposed by the harsh plasma environment on the vacuum production. The neutral particle balance and pressure development during plasma operation will briefly be depicted.

VA 1.2 Mon 9:45 H25

Vacuum solutions for ion thruster testing — •Stefan Lausberg — Oerlikon Leybold Vacuum, Bonner Str. 498, 50968 Köln, Germany

Electrical propulsion is the keyword for nowadays movement of space vehicles. Here ionized particles, usually xenon, are accelerated by thrusters in an electric field. State-of-the-art xenon thrusters emit a gas flow of 0.1 to 10 mg/sec. In order to maintain a high vacuum pressure at this flow in thruster test chambers, a large pumping speed is required, often in the range of 10'000 to 100'000 l/s for xenon. The benefit of a large mass for propulsion on the one hand is a huge challenge for vacuum pumps on the other hand. One of the reasons is the poor thermal conductivity of xenon gas which leads to critical temperature rises in gas transfer vacuum pumps like turbomolecular pumps. Moreover, dozens of large turbomolecular pumps would be necessary to reach the required pumping speed. We will show that big standard cryopumps are no appropriate solution either - even though they can principly provide large pumping speeds.

Oerlikon Leybold Vacuum has developed an optimized and simple cryogenic solution for xenon pumping. Strong single-stage Gifford-McMahon type cold heads carry metal discs which condense the xenon gas with a pumping speed at the edge of the theoretical limit. In this talk, we will present the whole vacuum system for a thruster testing facility.

VA 2: Vacuum Physics

Time: Monday 10:30–11:45 Location: H25

Invited Talk VA 2.1 Mon 10:30 H25

Novel routes in vacuum metrology at PTB and beyond — •Stephan Putzke and Karl Jousten — Physikalisch-Technische Bundesanstalt, Institut Berlin

At PTB, we have recently investigated and setup new standards for vacuum pressure calibrations which shall be detailed.

There are industrial processes which demand fast changes of vacuum pressure by several orders of magnitude in 1 second or less. Using a new standard at PTB, the response of fast pressure gauges can be characterized and calibrated from normal pressure down to the mbar range in a mere 20 ms. An overview over the needed complex gas-flow simulations will be given and compared to the experiment.

Simultaneously, a new standard for measurement of outgassing rates and generation of partial pressures in the high and ultrahigh vacuum regime has been setup which allows to prepare gas mixtures of up to three gases employing the continuous expansion method. This, for example, allowed us to compare in detail the performance of four different mass spectrometers (QMS) using the exact same prepared gas samples. Details such as total pressure and pumping effects will be discussed.

Our group is also concerned with (partial) pressure measurement using optical methods with which the typical problems of QMS can potentially be avoided. This includes effects like cross-sensitivity, pumping by the QMS, and total pressure effects. One such method is laser absorption spectroscopy using optical long-path cells. In a future project, we aim to access the total pressure in a system through the index of refraction, for which several concepts will be discussed.

VA 2.2 Mon 11:15 H25

Dynamic-XPS measurements by means of new Fast-XPS end-station based on Argus spectrometer at PETRA III — •Sergey Babenkov[1], Victor Aristov[1,2,3], Olga Molodtsova[1,4], Frank Scholz[1], Joern Seltmann[1], Ivan Shevchuk[1], Leif Glaser[1], and Jens Viefhaus[1] — [1]DESY, Hamburg, Germany — [2]ISSP RAS, Chernogolovka, Russia — [3]TU Bergakademie, Freiberg, Germany — [4]ITMO, Saint Petersburg, Russia

The experimental setup, based on a hemispherical electron spectrometer Argus (Omicron NanoTechnology GmbH), has been built up, commissioned and currently is available for regular users of PETRA III. The setup allows acquiring both traditional scanning and extremely fast snapshot (down to 0.1 sec/spectrum) XPS spectra of several core levels (CL). It opens new possibilities to real time characterization of the fast processes from quantitative and qualitative point of view by dynamical measuring of XPS. The concept was verified by real time XPS characterization of thermally induced process of graphene formation on model cubic-SiC(001)/Si(001) wafer. Moreover, we present the dynamic-XPS study of controllable metal-organic interface formation (Indium/CuPcF4) at room temperature conditions. This work was supported by grants of RFBR No 13-02-00818, 14-02-00949, BMBF-Project No. 05K12GU2, PSP-Element No. U4606BMB1211.

VA 3: Vacuum Generation & Measurement

Time: Monday 14:00–15:45 Location: H25

Invited Talk VA 3.1 Mon 14:00 H25

Development of an Absolute Valve for ITERs Neutral Beam Injection — •Martin Greuter and Verena Saissrainer — VAT Vakuumventile AG, Seelistr. 1, 9469 Haag, Switzerland

VAT vacuum valves was awarded a contract by ITER to develop a DN1600 All Metal Pendulum Valve that provides isolation between the ITER vacuum vessel and the beam vessel for its Neutral Beam Injection. For the thermomechanical and seismic analysis, a collaboration contract between VAT and the Culham Centre for Fusion Energy (CCFE) was signed. The presentation will give an insight into how the transfer of knowledge between Research Institutes and Industry can be leveraged to develop the largest All Metal valve ever, complying with design regulations such as RCC-MR, dimensional restrictions while maintaining the common functionality of a field proven VAT All Metal Valve.

VA 3.2 Mon 14:45 H25

Design development of a Linear Diffusion Pump — •Holger Strobel, Christian Day, Thomas Giegerich, and Ralf Müller — Institut für Technische Physik (ITEP), Karlsruher Institut für Tech-

nologie (KIT), Campus Nord, Eggenstein-Leopoldshafen, D-76344

In fusion power plants, the hydrogen isotopes deuterium and tritium are merged together to helium under the release of huge amounts of energy. The fusion reaction takes place in a plasma contained in vacuum. Fusion reactors require very large vacuum chamber and a powerful vacuum pumping system that is able to pump the reactor down and to keep the vacuum against a certain fuelling gas flow. For the primary pumps, linear mercury diffusion pumps (LDPs) have been proposed by KIT and are now under development.

The LDPs need to be supplied with mercury vapour (433 K), cool water (273 K) and a heat transfer fluid to supply the two internal baffles (180 K, 220 K) that trap the mercury inside the pump. The different temperature and pressure levels lead to high mechanical stresses in the pump case and thus require a full mechanical simulation of the pump using finite element methods. Furthermore, a bake-out of the pump must be possible and, for safety reasons, an internal explosion must be tolerated.

This talk gives an overview on the development of the LDP starting from a conceptual design. During this work, different load cases have been simulated using ANSYS and a more detailed design has been elaborated in an iterative process.

VA 3.3 Mon 15:15 H25

Turbo pump and measurement technology optimized for UHV-applications — •Andreas Kraft — Pfeiffer Vacuum, Berliner Strasse 43, 35614 Asslar

Keeping abreast of the latest news with your smartphone, seeing better thanks to high quality eyeglasses, and discovering the world independently while on the go in your car - these and many other conveniences of everyday living would be impossible without vacuum. Pfeiffer Vacuum - a name that stands for innovative solutions, high technology and dependable products, along with first-class service. For more than 125 years we have been setting standards in vacuum technology with these attributes. One very special milestone was the invention of the turbopump at our Company more than 50 years ago. Our extensive line of solutions, products and services ranges from vacuum pumps, measurement and analysis equipment right through to complex vacuum systems. Thanks to close collaboration with our customers from a wide variety of industries and our continuous focus on their needs, we constantly optimize and expand our product line. Among others the talk will present two of our newest developments in the field of ultra-high vacuum generation and measurement: A new 300 l/s turbopump with highest compression for light gases and improved ionization gauges.