VA 2: Vacuum technology: New developments and applications

Time: Monday 12:30–15:10 Location: H12

VA 2.1 Mon 12:30 H12

Experimental characterisation of a NEG pump of novel size - a major step to its application in neutral beam injectors of future fusion devices — •Stefan Hanke[1], Christian Day[1], Thomas Giegerich[1], Xueli Luo[1], Fabrizio Siviero[2], Michele Mura[2], Enrico Maccallini[2], Paolo Manini[2], Emanuele Sartori[3], Marco Siragusa[3], and Piergiorgio Sonato[3] — [1]KIT, Karlsruhe, Germany — [2]SAES Getters, Lainate, Italy — [3]Consorzio RFX, Padova, Italy

Future fusion plants require plasma heating including neutral beam injectors (NBI), demanding pumping speeds of several 1000 m3/s. A concept to replace the currently used customized cryopumps is based on the high capacity getter ZAO. In a 6 years systematic technology development, the concept of a NBI NEG pump was derived, starting with comprehensive material characterisation, expanded to pumping and regeneration characteristics of ZAO and to heating and thermal management of larger arrangements for scalability and control. The recent step was design, manufacturing and operation of a large NEG pump for demonstration and to confirm scalability. The resulting pump with 15 kg of ZAO was tested in the TIMO facility at KIT. The achieved experimental results, regarding sorption characteristics (depending on pressure, gas flux, getter temperature, loading of the getter with gas, isotope) and regeneration behaviour are described. Subsequently the entire setup was replicated in detail in the TPMC code ProVak3D to find the real sticking factor. With this, the performance of any advanced future arrangement of NEG cartridges can be predicted now.

VA 2.2 Mon 13:10 H12

Design process of the DTT divertor cryopump — •Volker Hauer and Christian Day — Karlsruhe Institute of Technology, Institute for Technical Physics, Karlsruhe, Germany

DTT is a planned, superconducting tokamak, which is to be built in Italy in the next few years. It will provide enough flexibility to test different divertor concepts and find the best concept for a subsequent demonstration power plant.

The plasma chamber in the center of the tokamak is actively pumped during operation. Nine cryopumps are used for this purpose due to the high pumping speed required.

The presentation shows the design process of the cryopumps starting from the boundary conditions, the calculation of pumping speeds by means of Test Particle Monte Carlo Simulation (TPMC), the selection of the optimal design and the necessary calculations for mechanical stability to the planned design of the cryopumps.

VA 2.3 Mon 13:50 H12

Outgassing rate studies and Monte Carlo simulations for the design of the cryogenic vacuum system of the Einstein Telescope — •Katharina Battes, Stefan Hanke, Xueli Luo, and Christian Day — Karlsruhe Institute of Technology, Eggenstein-Leopoldshafen, Germany

The Einstein Telescope (ET) is a third-generation underground gravitational wave observatory, currently under development in Europe. It is designed as an equilateral triangle with 10 km long arms and detectors in each corner. Two interferometers will be used to detect both low-frequency (LF) and high-frequency gravitational wave signals.

In order to reduce thermal noise, the main optics will partly be cooled to cryogenic temperatures below 20 K for ET-LF. The integral ET vacuum system requires high to ultra-high vacuum conditions and comprises three different parts: (i) the beamline vacuum characterised by outgassing from the pipe walls, (ii) the tower vacuum characterised by outgassing from the suspension arrangement, and (iii) the cryogenic vacuum systems around the LF mirror.

In this paper, the outgassing behavior of potential materials such as mild steel is studied at the Outgassing Measurement Apparatus OMA. Using this input, a Test Particle Monte Carlo model has been established with the KIT in-house code ProVac3D, to allow for a system analysis of the cryogenic vacuum area. It assesses the impinging rate of residual gas on the cryogenic mirror, depending on the particle sources. With that, the expected speed of frost formation is estimated, which is critical due to degradations of the optical performance.

VA 2.4 Mon 14:30 H12

Prevention of Carbon Contamination in Transmission Electron Microscopy by Sample-Specific Preparation — •Julia Menten[1], Daniela Ramermann[1], Robert Schlögl[1,2], and Walid Hetaba[1] — [1]Max Planck Institute for Chemical Energy Conversion, Mülheim an der Ruhr, Germany — [2]Fritz Haber Institute of the Max Planck Society, Berlin, Germany

Transmission electron microscopy (TEM) offers a powerful tool for the analysis of specimens down to an atomic scale. In order to achieve the best possible image resolution and quality of obtained data, sample preparation is a crucial step. Many samples contain a high carbon content, e.g. as organic ligands or solvents. Electron beam exposure can lead to the deposition of carbon on the specimen surface and limit the quality of the measurements.

In our work we focus on the removal of undesirable carbon species before the sample is inserted in the microscope. Our sample cleaning setup allows for investigation of the influence of different preparation parameters, e.g. drying time or temperature, on how long solvents remain in the vacuum system and therefore can have an impact on the TEM analysis. Evaluation of the decrease in pressure while pumping our setup with a TEM sample gives insight in necessary drying times. The effect of our sample treatment can be verified in the TEM by contrast and thickness measurements after electron beam exposure of the sample.