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Contribution ID: **255** Type: **Poster Presentation**

Pumping speed studies of activated carbons at 4.2 K adhered to indigenously developed hydroformed cryopanels

Monday, 29 June 2015 14:00 (2 hours)

For the fabrication of a cryopump with large pumping speeds for use in tokamaks, in particular, for gases such as helium and hydrogen, different activated carbon sorbents (with surface areas ~ 2000 m2/g) in the form of granules, spheres and cloths have been developed. These sorbents are adhesively bonded on a small size hydroformed (in-house developed technology) cryopanel of size ~500mm x 100 mm, and this constituted a Small Scale Cryopump Facility (SSCF). The pumping speeds of this SSCF for various gases have been measured as per AVS standards which comprises of a dome mounted with pressure gauges, calibrated leak valve and gas analyser. The SSCF cryopanel was shielded by LN2 cooled radiation shields and chevron baffles to minimize the heat in leak. The measured average pumping speeds for SSCF with the surface area of ~1000 cm2 for He and H2 at the constant panel temperature of 4.5 K, in the pressure range of 10-7 to 10-4 mbar, are ~ 2500 l/s and 2700 l/s respectively. The Pump performances for SSCF were also studied by using the test particle Monte Carlo simulation in Molflow+. The pumping speeds for different gases were analysed by varying the sticking coefficient and compared with the experimental results to find the sticking coefficients for helium and hydrogen. This paper describes the characterization and performances of different activated carbons, details of the SSCF experimental setup and the experimental results, the Monte Carlo simulation results and their comparison towards realizing the large scale cryopump.

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Session Classification: C1PoG - Thermal Analysis and Design

Track Classification: CEC-02 - Large-Scale Systems, Facilities, and Testing