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NEG Coating developing in ASTeC

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The ASTeC Vacuum Science Group has an ongoing study to improve the non-evaporable getter (NEG) coating which is currently used in many accelerators around the world. The main advantages of using NEG coatings are, an evenly distributed pumping speed, low thermal outgassing rates and low photon and electron stimulated gas desorption (PSD and ESD). The gas density along the accelerator vacuum chamber is proportional to desorption yield and is decreasing with sticking probability. Previously we reported that by vacuum firing prior to NEG deposition, the level of ESD of hydrogen reduced by an order of magnitude [1]. This depicted the dependence of ESD of hydrogen to the amount of hydrogen stored in the vacuum walls. In addition, the dense NEG coating provides lower than one ESD from the columnar film, but its pumping properties are reduced [2]. Our experiments demonstrated that a dual layer of NEG, where the dense layer acts as a barrier for hydrogen diffusion into the columnar layer, is further reducing the ESD of hydrogen and providing better pumping properties. An alloy target of Ti-Zr-Hf-V was used to deposit dense NEG followed by ˜1 um of columnar structure of NEG onto the inner surface of a 50-cm long stainless steel tube. The composition and structure of the dual layer were determined by Energy Dispersive X-ray spectroscopy (EDX) and Scanning Electron Microscopy (SEM) respectively. NEG coating ESD and pumping properties were measured on a dedicated in-house designed facility demonstrating improved properties of dual NEG coating layer.

[1] O.B. Malyshev, R. Valizadeh, B.T. Hogan and A. Hannah. Electron-stimulated desorption from polished and vacuum fired 316LN stainless steel coated with Ti-Zr-Hf-V. J. Vac. Sci. Technol. A 32, 061601 (2014).

[2] O.B. Malyshev, R. Valizadeh, R.M.A. Jones, A. Hannah. Effect of coating morphology on the electron stimulated desorption from Ti-Zr-Hf-V nonevaporable-getter-coated stainless steel. Vacuum 86, 2035 (2012).

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