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Photodesorption and Photoelectron Yields from Thin Film Coatings at Cryogenic Temperature

Title: Photodesorption and Photoelectron Yields from Thin Film Coatings at Cryogenic Temperature

Abstract: In the design of particle accelerators, for a precise estimation of the pressure profile along the beam chambers, it is essential to adopt an appropriate data of photon-stimulated desorption (PSD) yields into vacuum simulators, such as a combination of Synrad and Molflow. Additionally, in the design of proton or positron accelerators, it is required to cope with the electron cloud issues while taking account of an appropriate photoelectron yield (PEY) of the beam chambers. These PSD and PEY data should therefore be measured experimentally under similar conditions to the machines being designed, in terms of the energies of Synchrotron Radiation (SR), materials and surface treatments of vacuum chambers, incident angles of SR, etc. At CERN, a design study of the 100 TeV proton-proton collider named FCC-hh has been carried out under worldwide collaboration, and KEK has undertaken the PSD and PEY measurements using an SR beamline at Photon Factory, where SR with a critical energy of 4.0 keV is available. In FCC-hh, the beam screen will be operated at cryogenic temperatures ranging from 40 to 60 K while being irradiated by SR with a critical energy of 4.3 keV. In our previous measurements at room temperature, two thin film coatings, namely Non-Evaporable Getter (NEG) coating and amorphous carbon coating, were verified to have a sufficiently low PEY, and the NEG coating to have a sufficiently low PSD yield. For the FCC-hh study, these two possible coatings have been examined at a cryogenic temperature of 77 K while being cooled with liquid nitrogen, and it was found that not only the NEG coating but also the carbon coating exhibited sufficiently low PSD yields. These systematic measurements enabled us to verify and discuss the effect of the cryogenic temperature on the PSD and PEY properties of the thin film coatings.

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