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Outgassing of differently gold-coated copper samples

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Heavy ion ring accelerators suffer from dynamic vacuum increase due to ion-induced desorption. Lost beam ions collide with the vacuum vessel, trigger the release of gas and the resulting pressure rise leads to more beam loss. This self-amplifying effect is a severe intensity limitation and affects the design and operation of next generation heavy ion accelerators.
A common mitigation of the dynamic vacuum deterioration is the installation of ion-catcher systems in the loss regions. These so-called collimators ensure beam loss in a controlled manner. First, the impact angle of the lost ion is perpendicular, what leads to way lower induced desorption yields compared to grazing incidence loss. Second, the pumping speed in this area is increased. Finally, the collimator block on which the loss occurs can be made out of low-desorbing material. After years of research, gold-coated copper established as material with the lowest desorption yield amongst different irradiation beam parameters. The low stimulated desorption can be explained by the high thermal conductivity of copper. The gold coating prevents the surface from oxidation. As gold and copper diffuse into each other, a blocking layer out of chromium, nickel or silver is applied. Presently it is still under investigation, which of these materials is the best choice for diffusion prevention.
Technically there are three coating methods available for the application of the layers on top of the copper block. Coating by thermal evaporation and sputter coating both employ high vacuum environments, with an applied process gas pressure in case of sputtering. From that, the risk of process gas inclusions in sputter coatings exists. Sputter coatings have higher sticking forces to the substrate as compared to evaporation-coated layers. Electro-deposition on the other hand uses the most undefined environment with a high probability of impurity inclusions. The aim of this work is to investigate the content of volatile species such as C, N and O inside of the deposited layers for different coating methods and layer thickness. The volatile species are suspected to contribute to the desorbed gas and therefore have to be minimized. A measurement campaign has been started to determine the amount of volatile species in the layers by thermal desorption spectroscopy in a new dedicated setup. First results will be presented with the focus on layer thickness, material of the blocking layer and comparison of the coating techniques.

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