Improvement and characterization of small cross-piece tritium ionization chambers at the Tritium Laboratory Karlsruhe

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Real time and online activity measurement is essential for tritium process control. For this purpose ionization chambers are widely used, different chamber volumes allow to cover broad spans of activity.

In the Tritium Laboratory Karlsruhe (TLK) small cross-piece ionization chambers with an active volume of ~4.7 cm^3 are used for real-time in-line activity measurements of tritiated gases in experiments and tritium processing loops [1]. The applicability and accuracy of these chambers in the lower activity range suffers from the memory effect – decaying tritium bound on the stainless steel electrodes and chamber surfaces produces a memory current.

In principle, tritium trapping on gold and copper coated surfaces is smaller than on stainless steel [2, 3]. Therefore, two new cross-piece chambers were produced and coated with gold and copper in order to reduce the memory effect. Electroplating was chosen as the coating process.

The influence of the coatings on the chamber performance and on the memory effect was investigated. The chambers were tested and fully characterized with helium-tritium mixtures in direct comparison to a new non-coated chamber in the CAPER facility at the TLK [4].

This paper describes the design and the testing procedure of the chambers. It presents the first experimental results on the performance and memory effects as well as calibration curves.

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[4] B. Bornschein et al., „Successful experimental verification of the tokamak exhaust processing concept of ITER with the CAPER facility“ Fusion Sci. Technol. 48 (2005) 11