Tritium Outgassing from Contaminated Metal Surfaces

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A model was developed to explain tritium release from contaminated metallic surfaces [1]. This model describes the tritium release-rate dependence on time, humidity, temperature, and tritium inventory in the bulk metal for different metals.

An experimental program was implemented to validate the model. Aluminium, stainless steel, copper, nickel-coated copper, and gold-coated copper samples have been charged with tritium by exposing them to DT at room temperature for times ranging from 1 to 96 h. The samples were subsequently stored in dry helium and, when needed, transferred to a thermal desorption facility where the temporal evolution of the tritium release rate was measured under different environmental conditions. The desorbed tritium was measured with an on-line liquid scintillation counter.

Two rate-limiting steps are evident: HTO production-and-release dependence on water adsorbed on the metal surface, and tritium diffusion from the metal substructure. Enhanced tritium outgassing stimulated by an increase in humidity, anecdotally known as the “tritium puff” when a contaminated surface is first exposed to air, depends on the first rate-limiting step. However, the outgassing rate decreases with time as the near surface becomes tritium deficient, and the second rate-limiting step becomes important. The high initial outgassing rate can be recovered by storing the contaminated sample in a dry environment for one month or by increasing the metal temperature.

This paper will discuss the outgassing behavior of tritium from surfaces and compare those measurements against the model for the metals and desorption conditions mentioned above.

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[1] A Model for Removal of Surface-bound Tritium Using Humid Air, J. E. Fair and W. T. Shmayda, this conference