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Recent Results in Modeling of LANSCE H− Surface Converter Ion Source

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Models of the hot cathode performance and thermal arc discharge were used to estimate main plasma parameters and the sputtering rate of tungsten atoms. The hot filaments in H- surface converter ion source suffer from non-uniform mass loss that limits its operational lifetime. The dominant mass loss mechanisms used in the new filament model are: the thermal evaporation and plasma sputtering caused by heavy ions (Cs^+ and W^+). Light hydrogen ions (H^+, $H2^+$, $H3^+$) do not have an influence on the tungsten filament erosion in our ions source. Their maximal kinetic energies gained in near cathode region (up to 180 eV) are below the ion sputtering threshold energies. In several hot wire resistance measurements during the LANSCE beam production cycles, we have observed an increase of the filament mass erosion rates after the cesium transfer, following a change in cesium oven temperature or following a change to the arc discharge voltage. The filament lifetime analysis based solely on the simplified thermal evaporation was no longer applicable [1, 2]. We will discuss a set of experiments to separate and measure the different mass erosion contributions caused by the thermal evaporation and the heavy ion plasma sputtering.

References

[1] E. Chacon-Golcher, "Erosion and Failure of Tungsten Filament", LANL report LA-UR-08-5251 (2008).

[2] I. N. Draganic, J. F. O'Hara and L. J. Rybarcyk "Different Approaches to Modeling the LANSCE H− Ion Source Filament Performance"Rev. Sci. Instrum. 87, 02B112 (2016).

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