Emission Spectroscopic Diagnostics and Result Comparison of Theoretical and Experimental Investigations in the Cathode Region

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Paper dedicated to Professor E. Pfender on the occasion of his 70th birthday.

Emission spectroscopic diagnostics of electron temperature distribution and electron number density distribution in the cathode region of an electric arc in argon and argon-hydrogen have been carried out employing an OMA/spectrometer system. Electron temperature values have been derived from the emission coefficient measurements of argon atomic and ionic lines assuming that the upper level distribution of the excited states is in equilibrium with the electrons. Electron density distributions have been measured using Hα Stark broadening. Cathode surface temperature distributions have also been measured using single color and two color pyrometry with high spatial resolution. The experimental results are compared with results of a theoretical model formulated previously describing the arc cathode interaction.

The results show strongly differing distributions of the electron density and the electron temperature, indicating the effects of radial electron diffusion. This effect may lead to radially varying sheath potentials and to erosion rates increasing at lower cathode surface temperatures. Thermionic cooling is the major cooling mechanism of cathodes at high arc currents. But the work function of 2% thoriated tungsten cathodes increases during arcing due to fast evaporation of thorium from 2% thoriated tungsten cathodes.