Abstract Submitted
for the GEC06 Meeting of
The American Physical Society

Three – dimensional mapping of electron temperature and electron density in an arc – anode boundary layer GUANG YANG, JOACHIM HEBERLEIN, University of Minnesota — A DC transferred argon arc system, which allows control of the anode boundary layer by introducing cold cross flow, has been setup in our lab to recreate the situation in the anode region of a typical plasma spray torch. In this study, a laser Thomson scattering system, which can probe a location as close as 50 micron from the anode surface, has been developed and has been used to obtain electron temperature and electron density maps at different planes in the anode boundary layer. The effects of different operating conditions with different cross flow gases (argon and nitrogen) are presented. Our results have shown that increasing argon cross flow rate changes the arc attachment from a diffuse mode to a transition mode with multiple unsteady attachment spots and then to a constricted mode. The electron temperature in the attachment increases from 9000K to 13000K and the electron density increases from $5*10^{21}\mathrm{m}^{-3}$ to $1*10^{22}\mathrm{m}^{-3}$ as the arc attachment changes from a diffuse mode to a constricted mode. In a constricted mode, an extended non-equilibrium region with low electron density ($<10^{21}\mathrm{m}^{-3}$) and relatively high electron temperature ($\sim$5000K) is also formed. With nitrogen, the arc is constricted already at low cross flow rates. The three dimensional results allow the qualitative determination of the current and heat flux distribution in the anode boundary layer.

Guang Yang

Date submitted: 13 Jun 2006 Electronic form version 1.4