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Effect of cathode cooling efficiency and oxygen plasma gas pressure on the hafnium cathode wall temperature KOUSTUBH ASHTEKAR, ABB Inc., GREGORY DIEHL, JOHN HAMER, ESAB Welding & Cutting Products — The hafnium cathode is widely used in DC plasma arc cutting (PAC) under an oxygen gas environment to cut iron and iron alloys. The hafnium erosion is always a concern which is controlled by the surface temperature. In this study, the effect of cathode cooling efficiency and oxygen gas pressure on the hafnium surface temperature are quantified. The two layer cathode sheath model is applied on the refractive hafnium surface while oxygen species (O2, O, O+, O++, e-) are considered within the thermal dis-equilibrium regime. The system of non-linear equations comprising of current density balance, heat flux balance at both the cathode surface and the sheath-ionization layer is coupled with the plasma gas composition solver. Using cooling heat flux, gas pressure and current density as inputs; the cathode wall temperature, electron temperature, and sheath voltage drop are calculated. Additionally, contribution of emitted electron current (Je) and ions current (Ji) to the total current flux are estimated. Higher gas pressure usually reduces Ji and increases Je that reduces the surface temperature by thermionic cooling.

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