Abstract Submitted
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Student Excellence Award Finalist: Validated two-dimensional modeling of ablated carbon arc[1] JIAN CHEN, ALEXANDER KHRABRY, IGOR KAGANOVICH, ANDREI KHODAK, VLADISLAV VEKSELMAN, Princeton Plasma Physics Laboratory, HEPING LI, Tsinghua University — An atmospheric pressure arc discharge is a convenient method for the synthesis of carbon nanoparticles. To describe the rate of production of nanoparticles we developed two-dimensional self-consistent modeling of the entire carbon arc device. The developed fluid model takes into account the transport of heat and current in both plasma and electrodes in a coupled manner as well as multiple surface processes at the electrodes including the formation of the sheath, carbon ablation and deposition, thermionic emission, and radiation. Sheath is included in the model as a nonlinear boundary condition for particle and heat fluxes. This model is used to obtain a self-consistent solution that determines the arc and sheath voltage drops, current density, and heat flux without any prior assumption. The simulated ablation rate and plasma density are validated using our experimental data. Spot formation is observed at the anode. Simulations show that the spot radius increases with the arc current in accordance with our experimental data and our analytical model. Due to the anode spot formation, some of the ablated carbon from the spot region returns to anode periphery, thereby reducing the total ablation rate.

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