Abstract Submitted
for the GEC16 Meeting of
The American Physical Society

Fluid simulation of carbon arc plasma[1] KENTARO HARA, YEVGENY RAITSES, IGOR KAGANOVICH, Princeton Plasma Phys Lab — An arc discharge using graphite electrodes is known to produce carbon nanomaterials, e.g. nanotubes and fullerenes. In order to understand where and how such nanomaterials are synthesized, the plasma properties inside the arc discharge must be characterized. The mechanism of the carbon arc plasma is as follows. Carbon particles evaporate from the graphite anode, which is mainly heated by the electrons. Carbon atoms and ions condensate and form a deposit on the cathode, from which the electrons are thermionically emitted. A one-dimensional fluid model is developed to study the characteristics of the carbon arc plasma in atmospheric pressures. Sheath models for the anode and cathode are coupled to the fluid simulation to obtain the material temperature and sheath potential. In the model, thermal nonequilibrium is assumed and atomic carbon, dimer, and trimer are considered. A typical operating condition of a carbon arc plasma is discharge voltage of 20 V, discharge current of 60 A, the electron radius of 6 to 12 mm, and background pressure of 500 Torr. Transition from low to high ablation mode is obtained from the simulations with a smaller electrode radius and with a larger discharge current, which agrees with experimental observations.

[1]This work was supported by the U.S. Department of Energy, Office of Science, Basic Energy Sciences, Materials Sciences and Engineering Division.

Kentaro Hara
Princeton Plasma Phys Lab

Date submitted: 12 Jun 2016 Electronic form version 1.4