Abstract Submitted
for the GEC16 Meeting of
The American Physical Society

Unstable Behavior of Anodic Arc Discharge for Synthesis of Nanomaterials[1] SOPHIA GERSHMAN, YEVGENY RAITSES, Princeton Plasma Physics Laboratory — Fast imaging and electrical current measurements reveal unstable behavior of the carbon arc discharge for synthesis of nanomaterials. The arc column and the arc attachment region to the anode move in a somewhat sporadic way with a characteristic time in a 10^{-3} sec range. The arc exhibits a negative differential resistance before the arc motion occurs. A physical mechanism is proposed based on the thermal processes in the arc plasma region interacting with the ablating anode which leads to the shift of the arc to a new anode region. According to the transient heat transfer analysis, the time needed to heat a new anode region is also in a 10^{-3} sec range. For a 0.6 cm diameter anode used in our experiments, this time yields a frequency of about 200-300 Hz, comparable to the measured frequency of the arc motion. The voltage and current measurements show oscillations with a similar characteristic frequency. The thermal model is indirectly supported by the measured negative differential resistance of the arc discharge during arc oscillations. The observed unstable behavior of the arc may be responsible for the mixing of the flow of nanoparticles during the synthesis of nanoparticles leading to poor selectivity typical for the arc synthesis.

[1]The work was supported by US DOE under Contract No DE-AC02-09CH11466

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Date submitted: 10 Jun 2016 Electronic form version 1.4