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Electrical control of nanostructures synthesis in the arc discharge
ALEXEY SHASHURIN, JIAN LI, MICHAEL KEIDAR, The George Washington University — Arc synthesis of carbon nanotubes (CNT) is characterized by excellent production rate and high quality of synthesized nanotubes superior to many other methods. Our recent findings indicate that the plasma parameters play an important role in the CNT growth process. In this work we develop and apply the state-of-the-art single electrostatic probe technique for conditions of the anodic arc. The probe is equipped with fast electrically-controlled shutter able to operate on the millisecond time scale in order to prevent fast deposition of the probe and uncontrollable growth of collecting area. Two stages of the discharge are observed. During the initial stage, when anode is cold (about second after arc initiation), the arc is supported by the cathode jets, and conventional plasma V-I characteristic of single probe is observed (with electron saturation current significantly exceeding the ion saturation current). Later, when the anode is sufficiently hot, the discharge is switched to the mode when arc is supported by the anode ablation. The saturation currents of positive and negative charge carriers of the single probe V-I characteristic are close during this stage of arc. Currents detected by the probe at this stage are associated with various carbon nanostructures produced by the arc. Electrical charging of nanostructures by the discharge plasma enables possibility of in-situ electrical control of nanostructures synthesis in the arc discharge.

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