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Experimental and Numerical Study of the Carbon Arc: Plasma Properties in the Region of Nanotube Synthesis[1] VLADISLAV VEKSELMAN, ALEXANDER KHRABRY, IGOR KAGANOVICH, BRENTLEY STRATTON, YEVGENY RAITSES, Princeton Plasma Phys Lab — A carbon arc for nanomaterial synthesis was comprehensively studied using spectroscopic techniques and electrical measurements and modeled by specially modified computationally fluid dynamic (CFD) code ANSYS. The carbon arc plasma is generated and sustained by ablation of the graphite anode. In this study the plasma and carbon composition is fully characterized in the synthesis region that is important for understanding of synthesis of carbon nanomaterials by the arc method. We applied planar laser induced fluorescence (LIF) diagnostic to obtain instantaneous distribution of C_2 in carbon arc. In addition, the arc was characterized by optical emission spectroscopy (OES) and fast filtered imaging. Results of the current work revealed two main arc plasma regions defined as the arc core and the arc periphery different by composition of carbon species. The core represents the dense and hot plasma region conducting most of the discharge current which is self-consistently sustained. The arc periphery is colder and characterized by intensive formation of carbon molecules. The resulting radial distribution of carbon molecules has a distinguished hollow profile structure which is preserved regardless of the arc stochastic motion realized in some modes. These results are in agreement with results of two dimensional CFD simulations of the carbon arc under operating conditions used in experiments.

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