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Tracking Nanoparticle Growth in Pulsed Carbon Arc Discharge[1]

CARLES CORBELLA ROCA, SABINE PORTAL, George Washington University, JIANCUN RAO, University of Maryland, MADHUSUDHAN KUNDRAPU, Tech-X Corporation, MICHAEL KEIDAR, George Washington University — The dynamics of nanoparticle growth in pulsed anodic arc discharge has been studied in time-resolved mode. A fast probe was employed to extract material generated in a pulsed arc plasma held between two graphite electrodes. The probe motion was synchronized with the pulse phase and the exposure time to the plasma was set to 10 ms. The graphite anode was eroded in a Helium atmosphere (300 Torr) by an arc plasma pulsed at 1 Hz with 10% duty cycle, and showing 250 A of peak current. Structure and morphology of the probe depositions were characterized by Raman spectroscopy and scanning electron microscopy. A maximal deposition rate of 260 μm/s was measured 5 mm away from arc core during the pulse. The deposited layer is rich in carbon nanostructures (graphene platelets, nanotubes). The deposition during the inactive time was several orders of magnitude slower and consisted of amorphous carbon traces. Moreover, the nanoparticle distribution along the collecting probe is correlated with the pulse phase providing thereby information on particle transport. Pulsed nanosynthesis can be modeled as a periodical growth process, where the volume and propagation velocity of the growth region can be adjusted through modulation of the pulse signal waveform.

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