Abstract Submitted
for the DPP17 Meeting of
The American Physical Society

Gas Composition and Input Waveform Effects on Alpha-to-Gamma Transitions in CCRF Plasma[1] GAYATHRI SHIVKUMAR, SIVA SASHANK THOLETI[2], MAJED ALREFAE, SERGEY MACHERET, TIMOTHY FISHER, ALINA ALEXEENKO, Purdue University — Optimizing the production of carbon nanotubes, graphene and graphitic nanopetals is of great interest to the engineering community owing to their excellent electrical, thermal and structural properties. Roll-to-roll radio frequency chemical vapor deposition (RFCVD) uses capacitively coupled radio frequency (CCRF) plasma to grow carbon nanostructures from radical precursors generated in the plasma. The transition of the plasma from the α mode dominated by impact ionization in the plasma bulk and displacement current in the sheaths, to the γ mode dominated by secondary electron emission and conduction current in the sheaths, controls the heat and precursor fluxes onto the growth substrate. Thus, characterizing these transitions under various input conditions is imperative to the optimization of the deposition. In the current work, we model CCRF plasma using the Poisson equation, hydrodynamic model with drift-diffusion approximation for electrons, modified Maxwell-Stefan equations, and the heat conduction equation. The effect of input voltage, pressure, frequency and waveform on α-to-γ transitions are studied for argon and hydrogen discharges. The differences in properties between monatomic and diatomic gases are explored for square wave voltage input.

[1]Work was supported by NSF CMMI Grant No. 1344654.
[2]Now at COMSOL Inc.

Gayathri Shivkumar
Purdue University

Date submitted: 14 Jul 2017 Electronic form version 1.4