Abstract Submitted
for the GEC14 Meeting of
The American Physical Society

Nanoparticle heating at atmospheric pressures[1] NICOLAAS KRAMER, University of Minnesota - Mechanical Engineering, ERAY AYDIL, UWE KORTSHAGEN, University of Minnesota - Chemical Engineering and Materials Science — Plasma growth and crystallization of nanoparticles is an exciting new frontier both for plasma science as well as materials research. To date, the mechanisms of nanoparticle charging and heating in nonthermal plasmas have been studied and understood to some extent for low pressure plasmas. However, particle charging and heating at atmospheric pressures have been little explored. The fundamental processes of nanoparticle charging and heating are significantly different at atmospheric pressure compared to low pressures. Charging is determined through collision enhanced or hydrodynamic, mobility driven collection of ions by the nanoparticles rather than by orbital motion at low pressures. Nanoparticle heating reactions have to compete with nanoparticle cooling through convection/conduction to the neutral gas that is about 100-1000 times faster than at low pressure. Here, we present a Monte Carlo model that stochastically treats nanoparticle heating reactions such as electron-ion recombination and energetic surface reactions. Nanoparticle cooling through conduction/convection is modeled through a continuum model. The model indicates at atmospheric pressure, the nanoparticle temperature on average remains much closer to the gas temperature than at low pressure.

[1]This work was supported by the DOE Plasma Science Center for Predictive Control of Plasma Kinetics.

Uwe Kortshagen
University of Minnesota - Mechanical Engineering

Date submitted: 13 Jun 2014 Electronic form version 1.4