Abstract Submitted
for the GEC09 Meeting of
The American Physical Society

Model and experimental evidence of heating of nanoparticles in low-pressure silane plasmas[1] FEDERICO GALLI, UWE KORTSHAGEN, University of Minnesota — Recently we developed a nanoparticle-plasma charging-heating model which included the effect of collisions between ions and neutrals in proximity of the particles and showed that for pressures of a few Torr a charge distribution that is less negative than collisionless orbital motion limited theory is obtained. The model also predicted the nanoparticle temperature distribution and morphology (amorphous or crystalline) to be a function of ion density. To support the theory a batch plasma reactor was used to nucleate, grow and crystallize silicon nanoparticles. The nanoparticle size distribution and morphology were characterized using transmission electron microscopy, x ray diffraction and Raman light scattering. Experimental results indeed show a strong correlation between crystallinity and ion density, here measured with time and space resolution using a capacitive probe technique. The use of a simple floating potential probe method is also presented. The probe traces show distinctive features belonging to a nucleation and growth phase and a successive diffusional loss phase. A simple theoretical model is proposed to explain probe measurements as a function of the other plasma properties.

[1]This work is supported by the National Science Foundation under grant CBET-0500332.

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Date submitted: 12 Jun 2009 Electronic form version 1.4