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THE NANOPARTICLE FORMATION IN HYDROCARBON PLASMAS

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Abstract. This work presents controllable plasma polymerization of nanoparticles. Controlled production of nanoparticles with variable characteristics is important for different application fields, from technology to astrophysics. We present changes in material characteristics of nanoparticles due to variations of the gas mixtures, plasma characteristics and especially the role of temperature.

The phenomena related to dusty plasmas have an immense number of facets – from plasma crystals to applications in astrophysics or technology. One of the special aspects of this field is certainly the plasma polymerization of dust particles, resulting from homogeneous or heterogeneous processes, ("Dusty Plasmas", ed. Bouchoule 2003).

We present here results obtained in low–pressure capacitively coupled radiofrequency discharges, with variable gas mixtures. The plasma polymerization process and experimental set up used in our work are in detail described in Kovačević 2006, Berndt 2007. It is possible to claim that such polymerization process posses similarities to stellar outflow conditions (Chiar et al. 1998, Kovačević et al. 2005) and provides a convenient way to produce candidate carbonaceous interstellar dust analogs under controlled conditions and to compare their characteristics to astronomical observations (Kovačević et al. 2005, Stefanović et al. 2005). Moreover low temperature rf plasmas provide an excellent trap for the charged dust particles, enabling different in-situ methods like in-situ extinction measurements on the dust particles (from VUV to IR spectroscopy), mass spectroscopy and optical emission spectroscopy of gas phase species etc.

One of the important results concerns the role of the gas composition on the material characteristics of the nanoparticles. Even changes of the carrier gases (He, Ar, Xe) affect the plasma characteristics, and thus the material characteristics of plasma polymerized nanoparticles. One important direction in our work concerns the role of the gas temperature for the nucleation processes and the material characteristics. Further variations in material characteristics of our nanoparticles are obtained by annealing of collected particles. The temperature aspect is highly interesting for applications in the field of astrophysics (see the results presented recently by Mennella et al. 2008).

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