HYDROCARBON NANOPARTICLE FORMATION IN C2H2/AR DISCHARGE PLASMA

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The formation and growth of hydrocarbon nanoparticles in a reactive plasma is the result of a complex chemistry, a chemistry that itself strongly depends on the plasma parameters. Recently this phenomenon is not clear yet. In this work, first we developed a hybrid model for simulations of the 13.56 MHz discharge in a C2H2/Ar mixture.

This model combines a kinetic description for electron motion and the fluid approach for 6 negative, 16 positive ions. 146 chemical reactions were taken into account. We studied the formation of heavy hydrocarbons up to 12 carbon atoms. It was shown that both negatively and positively charged heavy hydrocarbons can be precursors for nanoparticles formation, since their densities are sufficiently large. Then we studied the influence of the portion of acetylene on the argon discharge properties, in particular, on the generation rate of the negative ions. The kinetic simulations of discharge using PIC-MCC algorithm were done for all plasma species. Varying discharge frequency and portion of C2H2 in the mixture, we found the regime with a maximal electron attachment rate and a maximal negative ion density. The occurrence of this maximum at different pressures is an important factor of nanoparticle nucleation rate.

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