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# Pulsed Plasma Polymerization of Acrylic Acid for the Synthesis of Carboxyl-Functionalized Nanoparticles

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Polymer nanoparticles (NPs) have great importance in various fields of science and technology including biology and medicine where they can be used for targeted drug/gene delivery and for imaging purposes. Typically, macromolecular systems are designed to comprise specific functional groups that ensure the bioadhesion. In the last decades, considerable attention was drawn to plasma polymerization of acrylic acid for fabrication of coatings rich with carboxyl functional groups. The COOH groups are known to support adhesion and proliferation of different kinds of cells and can be used as immobilization agents to anchor biomolecules. Here, we show that plasma polymerization of acrylic acid (AA) can be performed in a manner as to produce COOH-functionalized nanoparticles (NPs) rather than thin films. For this purpose, we operated a gas aggregation cluster source (GAS) in a mixture of AA and Ar under the pressure of 100 Pa. An RF powered (13.56 MHz) electrode was used to ignite the plasma in a pulsed mode. Duty cycle (DC) and effective power ($P_{eff}$) were found to be crucial parameters that influence the size, flux and chemical composition of NPs. Under constant $P_{eff}$ of 40 W the NP size varied from 100 to 30 nm with decreasing DC. At high values of DC, only individual NPs were formed whereas coagulation of the NPs into larger agglomerates was observed at low DC. The phenomenon suggests that the accumulation of electric charge on the NPs during the on-time and its loss during the off-time are the concurring mechanisms that determine the resultant morphology. The concentration of COOH groups in the NPs was found to pass through minimum with varying DC from 100% to 32%. The maximal concentration of 12 at. % was reached at the lowest DC value.

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