Dynamical properties of small clusters of Janus particles in RF-discharge plasma

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In recent years, several studies on mesoscopic systems of active particles have been conducted [1, 2]. However, the questions concerning structural transitions in these systems, energy transformation within them, and their evolution under various external conditions remain open. In this work, an experiment was conducted to study finite systems of active particles in an RF discharge. A voltage with a frequency of 13.56 MHz was applied to the parabolic electrode; then, melamine-formaldehyde particles, half-coated with molybdenum, were introduced into the discharge. The particles were charged by electron and ion fluxes and levitated above the center of the electrode. They were illuminated by a laser. The laser power was varied from 0.08 W to 1.2 W. The particle motion was recorded using a high-frequency video camera.

It has been discovered that the analysis of the particles' dynamics (kinetic energy and localization areas of the particles, fractal dimension of their trajectories) can be indicative of their composition. Specifically, we were able to distinguish different types of particles in the system under study: 1) Janus particles with a shifted center of gravity; 2) uncovered particles / particles with partial coating.

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