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Effect of the nature of plates taped on the powered electrode on dust-particles generated in a CH₄ radio-frequency dischargeWilliam Desdions¹, Isabelle Géraud-Grenier¹, François Faubert¹, Maxime Mikikian²,
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In a capacitively-coupled radio-frequency (RF) discharge (13.56 MHz) in CH₄, dust-particles are generated at low pressure (120 Pa). The gas is injected in the chamber with a flow rate of 5.6 sccm ($9.45 \cdot 10^{-3} \text{ Pa} \cdot \text{m}^3 \cdot \text{s}^{-1}$). The plasma is generated between two parallel plane aluminum electrodes: the upper one is powered (80 W) by the RF generator and the lower one is grounded. An impedancemeter follows the evolution of the plasma electrical parameters. In our conditions, the dissociation of CH₄ leads to the formation of dust-particles in the plasma bulk, and to the growth of a coating on the powered electrode. The dust-particles are trapped at the sheath boundary because of forces exerted on them, leading to the formation of dust-particle clouds parallel to the electrodes. When the dust-particles become too big and too heavy, they fall onto the grounded electrode, so they can be collected.

The purpose of this experimental study is to understand how the nature of the powered electrode can influence the plasma parameters and the dust-particles generation. First of all, the electrodes are cleaned with ethanol and sand paper. Then, thin plates of different materials are cleaned with ethanol and taped on the powered electrode with conductive tape. 60% of the powered electrode is covered with the plate. After this, the pressure is lowered and the chamber is filled with CH₄, and the plasma is turned on. After 15 minutes, the plasma is turned off. The dust-particles generated and the plates are collected in order to observe them by Scanning Electron Microscopy. The morphology of the coating formed on the powered electrode differs in function of the material of the plate. The diameter of the dust-particles and the electrical parameters of the discharge are also affected by the nature of the plate. Moreover, less dust-particles are generated when an insulator plate is taped on the powered electrode, compared to when a conductive plate is taped.

Keywords

Dusty Plasmas

Dust-particles

Methane

Radio-frequency