Simulating the process of dielectric substrate surface cleaning in high-voltage gas discharge plasma

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Abstract

The mechanism of cleaning the surface of dielectric substrates in a low-temperature high-voltage gas discharge plasma was investigated theoretically and experimentally. It is shown that the main factors affecting the surface cleanliness are the exposure time, discharge current, accelerating voltage. A universal dependence was obtained that relates the amount of change in the concentration of contaminants on the surface with the rate of removal of contaminants and the duration of exposure. Good agreement between the experimental data and this dependence is shown. It was determined that the minimum surface concentration of contaminations is achieved when the duration of exposure is at least 10 seconds, the discharge current is at least 10 mA, the accelerating voltage is 2-3 kV. A real example of etching of silicon dioxide grooves in low-temperature high-voltage gas discharge plasma in a mixture of freon - 14 (CF_4) and oxygen (O_2) shows the effect of the substrate surface purity on the geometric parameters of the formed diffractive microrelief. According to the research results, a technique has been developed for cleaning the surface of dielectric substrates in high-voltage gas discharge plasma, characterized by low cost and energy consumption, which allows cleaning the surface to a level of 10-9 g/cm^2.

Keywords: high-voltage gas, discharge plasma, discharge current, accelerating voltage, plasma in a mixture of freon.

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