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Plasma parameters measurement of microwave surfatron discharge applied in new plasma-enhanced-ALD

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In the last decades the atomic layer deposition (ALD) has proven to be almost an irreplaceable technique in many technological steps, widening both its principal variations and possible applications.
Preparation of ultra-thin films or 3D objects in a nanoscale is a key task in development of cutting-edge microelectronics, optoelectronics or catalytics technologies. This necessitate deposition of thin films of a high uniformity in both vertical and horizontal direction. The leading technological companies sees the plasma-enhanced(PE)-ALD as potent solution for achieving lower temperatures and higher speed of deposition.
In this work we utilized a Langmuir probe for two-dimmensional measuring of plasma density, electron temperature and plasma potential of a microwave surfatron plasma for development and implementation of plasma ALD system for low-temperature deposition of thin dielectric films with possibility of application of the atomic layer etching (ALEt). We investigated the plasma parameters for various combinations of surfatron nozzle geometry, gas pressure in a chamber, gas flow and gas mixture. We studied the possibilities of deployment of the multi-nozzle systems for achieving a sufficient level of homogenization of the plasma parameters, leading to production of a large area homogenous ALD thin films for industrial application. Obtained results proved that radial homogeneity of the plasma density can be improved when lower mass flow rate of working gas is used. On the other hand, for higher pressure in the chamber the plasma density rapidly decreased in axial distance from the nozzle outlet.
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Keywords
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