Vladislav Zyn, J Biot Phyt 2017

Mechanisms of a glow discharge polymerization

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Introduction & Aim: A classical glow discharge has the well-known non-uniform structure. Several lights and dark bands zones are visible clearly in a discharge gap independently of the chemical nature of a gas used. Every zone has its own mechanism of electrical processes. In the case of a molecular gas, these local primary electrical processes initiate further chemical reactions and determine their kinetics. So, it is natural to formulate the purposes of this work as to determine whether the above-mentioned zonal structure of the discharge is reproduced in the spatial distribution of the polymerization products, identify the local polymerization mechanisms, and determine their productivity and influence of each local electrical mechanism on properties of the products.

Method: The objectives were achieved by means of a joint analysis of various databases formed by different experimental techniques. The films were grown on various surfaces, such as electrodes, quartz probe of a microbalance, metalized glass plates, and thin quartz filaments having been stretched through the discharge in various directions. *In-situ* thickness measurements were carried out with an ellipsometer. The gas phase during the polymerization was monitored with the help of a mass spectrometer and laser probe. Plasma processed samples with grown films were studied by means of optical and electron microscopy, interferometry, IR spectrometry, ESR, ESCA, atomic scanning microscopy, analytical weighing.

Results: Identified at least five principally different polymerization mechanisms: Cathodic, anodic, surface chemical reactions, the formation of aerosols and their deposition on the substrate. It was traced, how and through which mechanism the identity of each local activation stage passes through all stages of the polymerization and appears in the properties of the film grow. The most powerful local mechanism is the cathodic one. The ion bombardment of the cathode surface provides the most rate of the synthesis and is responsible for creation peculiar structure and internal stresses of the film which have shock nature and are formed by the ion bombardment. The anodic mechanism is activated by an electron bombardment mainly responsible for the film growth at the surface of an anode. The energetic spectrum of the anodic polymerization rate demonstrates thresholds and peaks.

Conclusion: The information obtained allows one to choose one or another mechanism depending on the problem being solved and organize the process accordingly

Biography

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