Abstract

The presented work focuses on the study of plasma polymerization and plasma surface treatment at atmospheric pressure with the aim of creating hydrophobic layers on various substrates. In the experiments, nitrogen with an admixture of hexamethyldisiloxane (HMDSO) was used as the working gas, and the plasma source was a diffuse coplanar surface barrier discharge (DCSBD). The layers were deposited on aluminum and on two types of glass. Surface treatment was incorporated into the layer preparation process in the form of plasma treatment of the substrate prior to deposition and plasma treatment of the already deposited layer.

In the first stage of the work, a new reactor for plasma polymerization was designed and constructed, which allowed for fast layer preparation and low working gas consumption. The prepared layers were analyzed using WCA, ATR-FTIR, XPS, SEM, EDX, AFM, 3D profilometry, and nanoindentation testing. We also characterized the DCSBD plasma source and the plasma generated in the mixture of HMDSO and nitrogen by measuring electrical characteristics and OES.

We succeeded in preparing layers that exhibited a hydrophobic character, but showed low mechanical durability and homogeneity. SEM analysis revealed changes in layer morphology occurring after deposition. The aging effect of the layers was monitored both during storage in air and in a climate chamber, and a positive influence of UV radiation on the hydrophobicity of the layers was demonstrated. ATR-FTIR and XPS analyses confirmed the chemical stability of the layers over time.

In the final stage of the work, a DCSBD linear jet was used as an alternative plasma source, which, based on preliminary results, appears to be promising for further research in the field of plasma polymerization at atmospheric pressure.

Keywords: plasma polymerization at atmospheric pressure, DCSBD, HMDSO, functional coatings, hydrophobic coatings.