Nanostructured surfaces

Nanostructured silica films: surface roughness regulation by plasma treatment and nanoparticles

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Development of hydrophobic films is a high demanded trend for a variety of applications: architecture, autoglasses, solar cells etc. Since wettability is determined primarily by chemical composition and roughness of surface, there is a need for aimed regulation of these parameters. For aimed surface roughness regulation of sol-gel silica films, the combination of methods of pre-treatment of glass substrates by air or argon plasma and introducing of silica nanoparticles (NP) (AEROSIL® OX 50 from Evonik Industries) in the films were considered in current study. Two series of hydrophobic film samples were synthesized by sol-gel dip-coating method using $Si(OC_2H_5)_4$ based compositions (the reactant molar ratios $Si(OC_2H_5)_4$:HCl:H_2O were $1.0:5\cdot10^{-2}$:3.82 and $1.0:5\cdot10^{-4}$:3.82 for #1 and #2 series, respectively) followed by exposure in hexamethyldisilazane (HMDS).

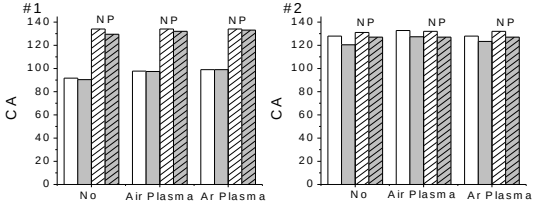

Fig.1. Water advancing (white) and receding (gray) contact angles measurement by tilted plate method.

It was found that the plasma treatment of the substrate insignificantly enhances hydrophobicity of samples of the first series without NP. Silica NPs were the determining factor of hydrophobicity for #1 series samples, but do not practically affect the hydrophobicity of #2 series samples. Surface topography rearrangement induced by formed NH_3 upon modification with HMDS was assumed for the samples of the series #2, the contact angles (CA) of ca. 120-130° were achieved for the films of both type: without and with introducing of NP.

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