Plasma Modification of Nanoporous Graphite Films

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Method of MPECVD was proposed to synthesize high porous amorphous carbon film with thin "adhesion" layer on various substrates in single cycle of the materials deposition. Annealing at high temperature in inert atmosphere leads to strong graphitization of the carbon film with significant decreasing of resistivity that allows us to consider obtained carbon films as promising material for catalysis and chemistry sensors. In this work we study plasma modification of the porous graphitizited carbon films in various gas atmospheres for enhancement of their catalytic and sensory properties.

The films were studied by X-ray photoelectron spectroscopy (XPS), X-ray diffraction (XRD) technique and by atomic force microscopy (AFM). Wetting of the films surface was studied by the water contact angle (WCA) technique; a resistivity of the films - by four point probes method. The samples were subjected by RF (13.6 MHz) plasma treatment in hydrogen, nitrogen or argon atmosphere at room temperature in vacuum of 10^{-2} Torr.

It was shown by XRD measurements that thickness and density of the carbon film after plasma treatments are changed insignificantly and equal to about 145 nm and 1.55 g/cm^3, respectively. XPS research demonstrates incorporation of nitrogen and oxygen bonds both after hydrogen and nitrogen plasma treatment and increase concentration of sp^3 carbon bonds; after Ar plasma treatment introduction of nitrogen and oxygen was minor. Nitrogen and hydrogen plasma treatment resulted in decreasing of WCA up to 28° that attests increasing of their hydrophilicity whereas an argon plasma treatment increases of WCA up to 64° (Figure 1 (a,b)) that can be associated with specific surface morphology in last case which we observe by AFM (Figure 1 (c)). Resistivity of the hydrogen plasma treated film considerable decreases in compare with initial one while it noticeably increases after nitrogen plasma modification. Nature of the observed phenomena is analyzed and sensory properties to ammonia are estimated.

Figures

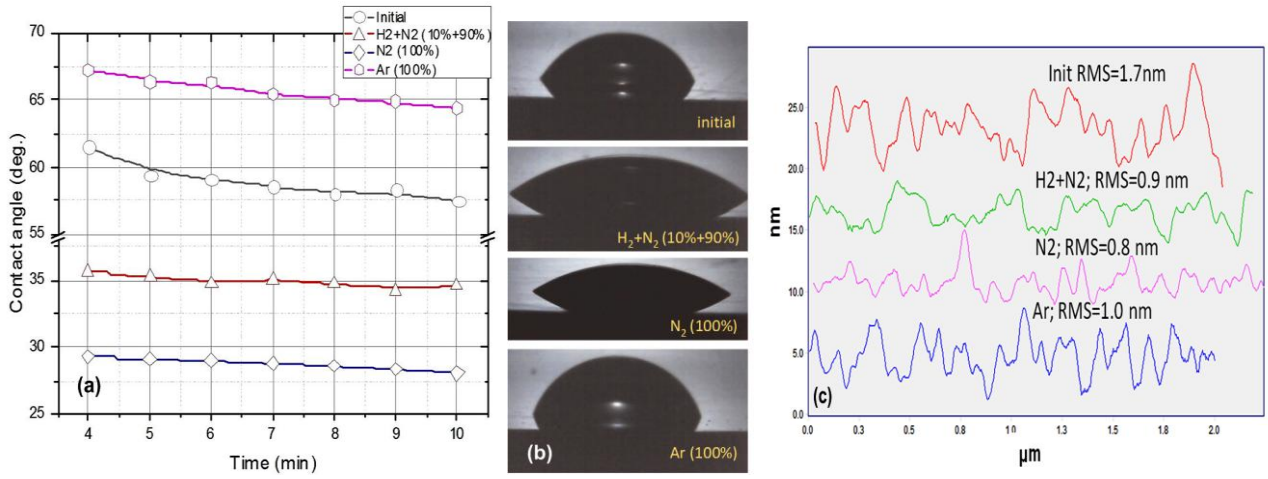

Figure 1. Water contact angle vs. time measurement after different plasma treatment (a); Photo of the drops located on grafitic surface after plasma treatment (b); Topography of graphite porous surface before and after plasma treatment measured by AFM technique.