Nanocrystalline and Ultrananocrystalline Diamond Films: a Difference in Wettability

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To know the wettability of thin coatings is important for applications in microfluidic devices, biomedicine, electrochemistry. In particular, superhydrophobic and surerlyophobic surfaces are coming into practice. Surface chemical treatment and/or nanotexturing can manipulate the wetting in a wide range. It was shown recently, that H-plasma-treated ultrananocrystalline diamond (UNCD) films can be much more hydrophobic compared to single crystal or microcrystalline CVD diamond, and much more hydrophilic after oxidation under the same conditions [1]. This was ascribed to peculiarities of the UNCD film relief and composition, including an enhanced contribution of grain boundaries in surface energy.

Here we attempt to compare experimentally the wettability of UNCD and nanocrystalline diamond (NCD) films, the latter having similar grain size (of the order of 10 nm), but grown under conditions typical for synthesis of microcrystalline CVD diamond, providing very high nucleation density. Both types of the films with thickness from ca. 100 nm to a few microns were deposited in a microwave plasma: the UNCD using $Ar/CH_4/H_2/N_2$ mixtures, and the NCD using CH_4/H_2 mixtures. The substrates were Si wafers seeded with detonation nanodiamond. Another substrate material was nanodiamond-pyrocarbon composites (NDC) [2], produced by carbon infiltration in porous detonation nanodiamond template. Those substrates did not require the seeding pre-treatment. The films were characterized by Raman spectroscopy, SEM and AFM. The UNCD showed a globular structure, while facetted nanograins could be seen for NCD.

Advancing contact angle θ for water and glycerol were determined by a sessile-drop method for different films and NDC substrates as well. The measured θ data will be reported for hydrogenated and oxidized surfaces, and discussed taking into account a difference in ultrafine grain structure, surface topography and presence of nondiamond components in the films.

[1] L. Ostrovskaya et al. *Diamond Relat. Mater.* **16**, 2109 (2007).
[2] V. Ralchenko et al. *Diamond Relat. Mater.* **8**, 1496 (1999).