CVD Diamond Nanowires

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The recent synthesis of diamond nanowires (DNW) by a microwave plasma CVD process (MPCVD) [1, 2] added a new structure to the family of nanocarbons, comprising, in particular, of nanotubes, fullerenes, onions and (spherical) nanodiamonds. The quasi-one-dimensional DNW are expected to have higher mechanical strength and lower band-gap compared to the bulk diamond. This can open opportunities to build diamond-based nanodevices, develop new composites with improved mechanical properties, and explore doping of diamond on nanoscale.

We report on DNW growth in form of ultrananocrystalline diamond (UNCD) films on Si and diamond substrates by MPCVD in $CH_4/H_2/Ar/N_2$ mixtures with N_2 added to the process gas in high amounts, up to 30%. The films structure was examined with SEM, TEM, AFM, XRD, optical absorption and Raman spectroscopy. The DNW are the single crystal rods of 5-6 nm in diameter and 100-150 nm long, formed at N_2 addition above some critical content (typically >20%). The DNW always are coated with a more or less ordered graphitic envelope with thickness from a few atomic layers to more than 5 nm.

Attempts to clean UNCD from nondiamond components and even to isolate the DNW were performed using the UNCD etching in oxygen, H plasma, oxidizing solutions, and by a gentle excimer laser ablation. As a result porous films with thinned DNW were produced. Sandwiches UNCD/CVD diamond have also been prepared using the same MPCVD system.

The role of nitrogen in DNW growth will be discussed, and potential applications of DNW will be considered.

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