Aerosol spraying of detonation nanodiamond for seeding and growth of transparent B-doped CVD nanodiamond films

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Transparent in ultraviolet (UV) region nanodiamond (ND) conducting films are necessary for creation of UV photoconverters and electroluminescent structures. In UV region it is necessary to be particularly attentive to receiving of smooth ND films to decrease the loss connected with light scattering by devices interfaces. For growth of smooth transparent diamond films you should create on the substrate a high density of diamond nucleation centers ($>10^{10}$ cm^{-2}). At present time the using of detonation nanodiamonds (DND) as nucleation centers for diamond films growth by the CVD deposition method is more widespread.

In this paper we report about development of new method of aerosol spraying of DND on silicon and quartz substrates with diameters less than 100 mm and receiving on them boron-doped ND films with surface roughness not exceeding 15 nm by the MWPECVD method. We investigated the change of transparency and conductivity of obtained films depending on boron concentration and on methane content in the methane-hydrogen gas.

During aerosol spraying we used a DND water suspension with average size of DND particle agglomerates about 40 nm, received by the additional treatment of industrial DND powder produced by SCTB «Technolog» (St.-Petersburg). We used diborane as a doping impurity in the MWPECVD process.

It is shown that by modifying of the DND deposition time and weight concentration in suspension over the range 0.001–1% you can change the DND agglomerates form and quantity per unit area of substrate surface from 10^8 to 10^{11} cm^{-2}. The optimization of MWPECVD conditions and the deposition of the DND nucleation layer with more amount of nucleation centers of diamond phase per unit area (10^{10}-10^{11} cm^{-2}) allowed us to receive a transparent in UV – visible region (T~50% at λ=300 nm) conducting (σ = 1–5 Ω^{-1} cm^{-1}) ND films on quartz substrates. The high content of diamond phase in these films was confirmed by the Raman spectroscopy method.