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Boron-doped diamond synthesized at high-pressure and high-temperature with metal catalyst Fedor M. Shakhov^{*,1,3,5}, Andrey M. Abyzov², Sergey V. Kidalov¹, Andrey A. Krasilin¹, Erkki Lähderanta², Vasiliy T. Lebedev³, Dmitriy V. Shamshur¹, Kazuyuki Takai^{*,5}

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Keywords Boron-doped diamond; high-pressure high-temperature synthesis; boron content; superconductivity; conducting diamond.

Abstract

The boron-doped diamond (BDD) powder consists of 40-100 μm particles was synthesized at 5 GPa and 1500–1600 $^{\circ}\text{C}$ from a mixture of 50wt% graphite and 50wt% Ni–Mn catalyst with an addition of 1wt% or 5wt% boron powder. The size of crystal domains of doped and non-doped diamond was evaluated as a coherent scattering region by X-ray diffraction (XRD) and using small-angle neutron scattering (SANS), being ≥ 180 nm (XRD) and ~ 100 nm (SANS). Magnetic impurities of NiMn_x originating from the catalyst in the synthesis, which prevent superconductivity, were detected by magnetization measurements at 2-300 K. X-ray photoelectron spectroscopy, the temperature dependence of the resistivity, XRD, and Raman spectroscopy reveal that the concentration of electrically active boron is as high as $(2 \pm 1) \times 10^{20}$ cm^{-3} (0.1 at.%). To the best of our knowledge, this is the highest boron content for BDD synthesized in high-pressure high-temperature process with metal catalysts.

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