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Belarusian HPHT diamonds. Material properties and detector characteristics

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Synthetic diamond crystals grown by the HPHT (High Pressure High Temperature) technique have impurities, such as nitrogen and metallic catalysts, as well as inclusion and structural defects, which result in variations of optical and electrical properties for crystals obtained by different producers.
In Belarus, synthetic diamonds (trademarked as STM Almazot) are manufactured at the Science and Technology Center "Adamas"[1]. The diamond single crystals, conventionally synthesized by the high pressure (4.5–5.0 GPa) and high temperature (1350–1450 °C) gradient technology using the Ni–Fe–C liquid solvent/catalyst carbon metallurgy system, were investigated. Growth was carried out of about 65–70 h. The solvent/catalyst system comprised the 70% Fe and 30% Ni metals in crystal growth cell, respectively.
To characterize the diamond crystal, it was sliced to form diamond plates. The sizes of individual diamond plates vary between 4–20 mm2 (area) and 0.2–0.4 mm (thickness). The plates were investigated by different experimental techniques: optical absorption, photo- and cathodoluminescence and ESR methods [2]. It has been found that STM Almazot crystals have strongly nonuniform impurity and defect distributions.
To select plates for detector structures, photoconductivity measurements have been used. Electrical contacts have been formed using boron implantation followed by activation annealing in vacuum. Spectrometric, dosimetric and pulse characteristics of test detector structures were studied, as well as the spectral characteristics of photoconductivity in the UV range. It is shown that the dosimeters, pulse radiation detectors and photodetectors for the UV range have high performance characteristics which are comparable with those of the detectors made of natural type IIa diamond. Small local regions with extremely high sensitivity to radiation have been found in the STM Almazot crystals. These regions can be used to fabricate devices for small field dosimetry.

1. www.adamas.by
2. E. Gaubas, et al.. Diamond and Related Materials, 47 (2014): 15-26

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