EPITAXIAL LATERAL OVERGROWTH OF HIGH-QUALITY SINGLE CRYSTAL DIAMOND THROUGH SELF-ASSEMBLED POROUS COLLOIDAL SiO_2 OPAL MASK*

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Diamond, with its exceptional properties, is of ever-increasing interest for applications in electronics and photonics. Growth of high-quality single crystal diamond (SCD) with reduced defect density by CVD technique is a challenge. Particularly, threading dislocations spreading across the diamond film, and often starting from the substrate/film interface, are harmful for the device performance. One of effective ways to reduce the dislocation density is epitaxial lateral growth (ELO) based on blocking the dislocations by a patterned mask (a grid of metal strips, for example) on the substrate, allowing the epitaxy within open windows only [1]. With growth time, the diamond envelops the strips and bury them, while keeping single crystal structure. We present a novel type of the mask for diamond ELO, consisting of a few monolayers thick self-assembled face-centered cubic lattice of submicron SiO_2 spheres. The method is simple, and does not require a lithography technique for the pattern definition. The SiO_2 spheres of 245 nm diameter were produced by a modified Stöber method. The porous opal film was deposited on HPHT diamond substrates, then the epitaxial film was grown from bottom by microwave plasma CVD in a CH_4-H_2-O_2 gas mixture [2]. After penetration through a system of voids in the opal the diamond layer formed a continuous smooth film on its top. The single crystal structure of the produced diamond is confirmed with TEM and EBSD analysis. The structure of the interface and the bulk film is characterized in detail with TEM. In addition, Raman and photoluminescence spectroscopy were used to further characterize the SCD samples. It is concluded that the realized ELO version is promising for growth of low-defect SCD diamond material, particularly for electronic devices and radiation detectors.

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