Application of ion beam technology for the production of single crystal CVD diamond plates

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Abstract: Single crystal diamond is one of the promising materials for feature electronic devices, such as power devices, radiation detectors and electron emitting devices due to its superior electronic properties. Most of these applications require a high-quality homo-epitaxial CVD diamond film grown on a single crystal diamond substrate. However, the size of commercially available single crystal diamond substrate is very small (typically less than 5 mm square) and this has been one of the major obstacles for the practical use. To overcome the situation, we have developed CVD growth technique for synthesizing large substrates. As the result, CVD diamond has been grown at very high growth rate (>100 μm/h) and a half-inch single crystal CVD diamond plate has been successfully synthesized. In addition, we have also developed a fast and reliable wafer production process by utilizing the lift-off process using ion implantation which is originally developed by several groups in 1990's. By this process, thick CVD diamond grown layer (typically a few hundred micron) can be easily separated from the substrate with very small cutting loss comparable to the range of the implanted ions. The diamond substrate or the separated CVD diamond plate can be also used as a seed substrate for further production of diamond plates. This process has been successfully applied to the half-inch CVD diamond plate resulting in producing a number of half-inch free-standing single crystal CVD diamond plates.