Synthesis of High Quality Diamond Substrates by Microwave Plasma Enhanced Chemical Vapor Deposition Method.

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ABSTRACT:

The Microwave Plasma Enhanced Chemical Vapor Deposition (MPCVD) is a prominent method for growing qualitative diamond crystals at relatively low temperatures and pressures. MPCVD method was employed to optimize the synthesis parameters, which include substrate temperature ranging from 800 to 900 ºC, gas pressure between 150 to 180 Torr, and the volume concentrations of CH_4 and H_2 used during the deposition process. The simultaneous changes in the growth parameters and their analysis improved the growth quality of the obtained samples. The substrate temperature was measured using an infrared pyrometer, and the flow rate of each gas was regulated using a mass flow controller. The quality of the grown samples was enhanced by the High Pressure High Temperature (HPHT) process, which was verified by Raman Spectroscopy and High Resolution X-Ray Diffraction (HRXRD). Raman Spectroscopy was carried out in order to confirm diamond phase of grown sample. HRXRD analysis was performed to evaluate the orientation of the crystallography phase in grown samples. The value of FWHM of the rocking curves in HRXRD reflects the quality of the homoepitaxial layer. The obtained diamond crystals have outstanding material properties that can enable exceptional performance in applications such as medical diagnostics, radiation detectors, optical components for laser windows for RF and microwave transmission, mechanical applications such as cutting and brushing tools, and electrodes for electrochemical sensing.

Keywords: Single Crystal Diamond, Microwave Plasma Enhanced Chemical Vapor Deposition (MPCVD), Optical Properties, Raman Spectroscopy, HRXRD.