HIGHLY PHOSPHORUS-DOPED POLYCRYSTALLINE DIAMOND GROWTH USING PULSED GAS CONDITIONS

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The production of high-quality phosphorus-doped diamond layers is crucial for the development of diamond-based electronic devices such as PIN diodes and fieldeffect

transistors. In this work, phosphorus-doped polycrystalline diamond layers were grown by MicroWave Plasma Enhanced Chemical Vapor Deposition (MWPECVD) using a new gas control process involving pulsed CH4 flow to increase the incorporation of phosphorus in diamond. Using this method, high quality polycrystalline phosphorus-doped diamond layers with a sp3/sp2 carbon ratio over 75% were grown on Si substrates. The phosphorus concentration, measured by Glow Discharge Optical Emission Spectroscopy, reaches a record high value well above 1020 cm-3. Additionally, to better understand the dynamics of precursor gases in pulsed growth conditions, the dynamic response of different gases (N2, CH4, and O2) impulses in hydrogen plasma was studied in two different MWPECVD reactors: a lab made NIRIM type reactor, and a commercial reactor made by Seki Diamond Systems. These reactors of different volumes were operated at different pressure and total gas flow. The time responses to the precursor gas injection were recorded by Optical Emission Spectroscopy (OES). Experimental time responses were fitted using an impulse response equation. Fitting parameters were extracted and compared for the different reactors, gases, total gas flow, and pressure conditions. The time responses of the different reactors were discussed as a function of their volume and the operating conditions.