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Evolution of heteroepitaxial (001) diamond films on (001) Ir/YSZ/Si substrates MURARI REGMI, KARREN MORE, GYULA ERES, Oak Ridge National Lab — We present new results on the heteroepitaxial diamond growth on Ir/YSZ/Si multilayer substrate assembly using microwave plasma chemical vapor deposition. A 150 nm thick epitaxial yittria stabilized zirconia (YSZ) is grown on (001) Si using pulsed laser deposition followed by 150 nm of Ir using e-beam evaporation. Methane in hydrogen was used as the carbon source. Nucleation of epitaxial diamond crystals is induced by bias enhanced nucleation (BEN). The effects of bias voltage, bias time, and methane concentration on the nucleation density and the Ir surface structure are studied systematically using SEM, AFM, and high resolution TEM. An epitaxial diamond nucleation density higher than 10^{11} cm^{-2}has been demonstrated with optimized BEN. At these high nucleation densities diamond crystals start coalescing after only a few minutes of growth. Continuous, uniform thickness diamond films, without visible coalescence boundaries, have been grown in just 20 minutes. TEM images of thicker films produced by continual growth show a defect band on the order of 1 micrometer localized at the diamond/Ir interface. Past this thickness the defects dramatically decrease in density, resulting in single crystal diamond that is of higher crystalline order than the underlying Ir as confirmed by X-ray diffraction.

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