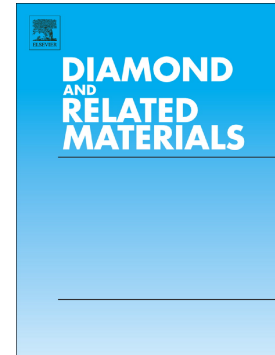


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Growth processes of nanocrystalline diamond films in microwave cavity and distributed antenna array systems: a comparative study

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Abstract

The growth process of nanocrystalline diamond (NCD) films has been investigated and compared in two different types of microwave plasma reactors. One process occurs at high substrate temperature (1170 K) and moderate pressure (few hundreds hPa) in a bell jar (BJ) microwave cavity system working in an Ar/H₂/CH₄ gas mixture. The second process occurs at low substrate temperature (below 670 K) in a low pressure (< 100 Pa) microwave distributed antenna array (DAA) reactor using a mixture of H₂/CH₄/CO₂ as feed gas.

NCD films synthesized in both reactors show a grain size around 20 nm and a strong <110> fiber axis, whereas some slight disparities are observed concerning the film morphology, topography and purity. However, the growth rate is about 30 times higher in the BJ reactor. Similarities and disparities are discussed by considering possible growth mechanisms and the activation energy estimated at 3.2 and 9.0 kcal.mol⁻¹ for the DAA and BJ reactors, respectively, for the considered substrate temperatures.

The microwave discharges were investigated by plasma modeling in case of the BJ reactor and by optical emission spectroscopy (OES) in the visible spectral range and laser absorption spectroscopy in the mid-infrared spectral range (MIR-LAS) in the case of the DAA reactor in order to determine major and key species densities as well as the gas temperature nearby the

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