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Electrostatic Charging and Substrate Seeding in Gas Phase Synthesis of Nanocrystalline Diamond Powder

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Synthesis of nanocrystalline diamond powder was investigated via a gas-to-particle scheme using the hot filament chemical vapor deposition. Effect of substrate surface seeding by nano diamond powder, and that of the electrical conductance of the substrate were studied. The substrate temperature, methane content in the precursor gas, filament-substrate distance and filament temperature were 670°C, 5% methane in hydrogen, 10 mm and 2400°C, respectively. The powder formation by gas-to-particle mechanism were greatly enhanced by the substrate seeding by the nano diamond powder. It was attributed to the removal of the electrostatic force between the substrate and the seeded nano diamond particle by the thermal electron shower from the hot filament, via the depolarization of the substrate surface or the attached diamond powder and subsequent levitation into the gas phase to serve as the gas-phase nucleation site. The powder formation was greatly favoured by the conducting substrate relative to the insulating substrate, which proved the actual effect of the electric static force in the powder formation.