Diamond Nucleation on Silicon using an Intermediate Temperature Step

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Substrate pretreatment by ultrasonic vibration in a suspension of diamond powders and seeding with diamond powders are simple and effective techniques for the enhancement of diamond nucleation. We studied the nucleation of diamond films on silicon (100) and (111) substrates pretreated with classical ultrasonic scratching. For this purpose, the as-treated substrates were exposed to intermediate temperatures prior to growth. An in-situ interferometric method was used as a surface diagnostic tool to monitor the early stages of diamond deposition.

In order to investigate the influence of the processing conditions on the density of diamond particles, a range of intermediate temperature (250°C, 350°C at 1,5% CH4:H2 , gas pressure 15 Torr, filament temperature 1950°C) was chosen. The final CVD growth step supposed to increase the diamond particle size always was carried out under identical conditions (1sccm CH4, 100 sccm H2, gas pressure 20 Torr).

In another series of experiments, the influence of gas pressure was investigated and similar nucleation experiments were carried out at 1 Torr. In this case, the intermediate step temperature seemed to affect the grain morphology. The other deposition parameters in this case were 10%CH4:H2 , and substrate temperature 700°C.

It follows from these experiments that the low temperature intermediate step and the duration of its application are key factors for the nucleation of diamond: The nucleation density increases with a decrease of the intermediate temperature, Particle morphology depends on intermediate temperature, duration of the intermediate step, gas pressure, gas composition, Uniform particle distributions are obtained after application of intermediate temperature steps