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Nano crystalline diamond Microwave chemical vapor deposition growth on three dimension structured Si substrates at low temperature

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The unparalleled hardness, low friction and heat conductivity properties of diamond make it attractive for many applications. The use of diamond as a coating has increased with the development of high growth-rate protocols using Hot Filament Chemical Vapor Deposition (HF-CVD), which usually operates at high substrate temperatures around 600 to 900°C. Nano crystalline diamond (NCD) films grown at a temperature below 400 °C can open new applications on temperature sensitive substrates. One requirement for the applicative use of NCD is the ability of depositing on a structured substrate having high aspect ratio. This work presents a study on the three dimension (3D) conformity of NCD deposition at low temperature (350°C) and low pressure (30 Pa). Silicon wafers have been structured using a mask-less Deep Reactive Ion Etching (DRIE) process and seeded with nano-diamond particles. The NCD films were grown on these 3D patterned Si substrates with various trench geometries to provide means of determining the limiting geometries of this technique. The NCD deposition system employs a set of Hi-Wave microwave antenna each connected individually to a solid state microwave power generator. By measuring the step coverage with changing trench width, a threshold for conformal NCD growth can be determined. The NCD films at the bottom of the 100 µm deep trenches were continuous down to an aspect ratio of 1:7.

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