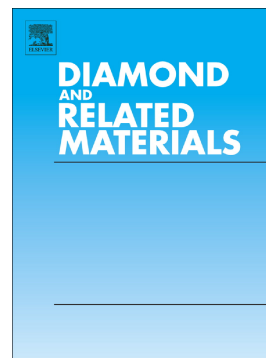


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## Growth Evolution of Carbon Film on the Hydrocooling Copper Substrate by DC Arc Plasma Jet

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**Abstract:** The growth process of carbon film on the surface of hydrocooling copper substrate in high-density direct current (DC) arc plasma was studied. Scanning electron microscopy, Fourier transform infrared spectroscopy, X-ray diffraction, nuclear magnetic resonance spectroscopy, and UV confocal Raman spectroscopy were used to analyze the structural constituents of the intermediate products generated at different growth periods. Results show that despite the remarkable heating effect of DC arc plasma to the copper substrate, one layer of cauliflower saturated carbon and double carbon bond as main component loose matter are first formed because of water-cooled copper substrate. With the increase in thickness of carbon film, the surface temperature gradually increases, the etching ability of the atomic hydrogen is enhanced and high concentration reactive units are maintained on the surface of carbon film. The cauliflower structure may effectively reduce the diamond nucleation barrier and promote the generation of nano-diamond. The diamond grains gradually grow up to the micron scale by the continuing influence of carbon-based active group and plasma. The growth pattern of carbon film on the hydrocooling copper substrate in high-density DC arc plasma may provide a new way to prepare large crack-free diamond films.

**Keywords:** DC arc plasma jet; hydrocooling copper substrate; carbon film; cauliflower surface

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