Low temperature hot filament chemical vapor deposition of Ultrananocrystalline Diamond films with tunable sheet resistance for electronic power devices

Objective

To study the properties of the UNCD synthetized by HFCVD when varying the position of the hot filament, show the importance of the control of the parameters and the further applications of the synthetized films on electronic devices.

Sample preparation

The simples were prepared by the HFCVD technique, using CH_4 and H_2 as precursors. They were synthetized over 400 °C and 450 °C substrate temperatures, but a different filament-substrate distance. The Tungsten filament was placed on a Mo frame.

Data acquisition conditions

"X-ray diffraction (XRD, Rigaku Ultima III, Cu Kα radiation, 1.542 Å)."

Reference

J. Alcantar-Peña, J. Montes, M. Arellano-Jimenez, J. O. Aguilar, D. Berman-Mendoza, R. García, M. Yacaman, O. Auciello, Low temperature hot filament chemical vapor deposition of ultrananocrystalline diamond films with tunable sheet resistance for electronic power devices, Diamond and Related Materials 69 (2016) 207 -213.

Representative figure /results

The crystallinity and grain sizes of UNCD films were investigated using XRD. "The XRD analysis shows that the d-spacing in the diamond lattice, calculated from Bragg's law, is decreasing from 2.0559 Å for the film grown at 20mm filament-substrate distance to 2.0488 Å for the film grown at 35mm filament-substrate distance, which relates to a reduction of the lattice constant from 3.5609 Å to 3.5487 Å, thus revealing that the UNCD films are under compressive stress" In other words, the graphitic phase was the dominant.

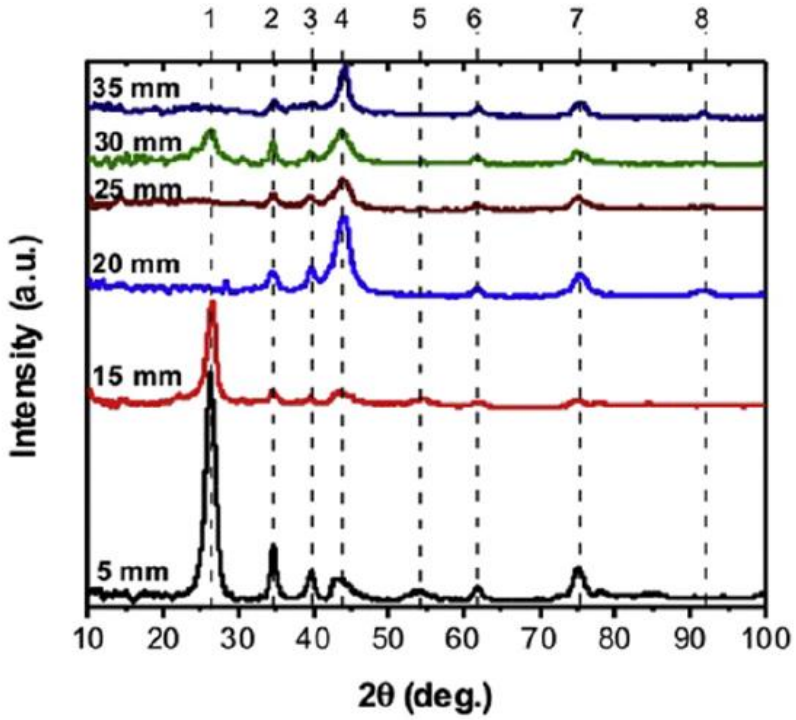

Fig. 6. XRD spectra from analysis of films grown at 5 mm, 15 mm, 20 mm, 25 mm, 30 mm and 35 mm filament-substrate distance at 450 °C heater temperature. The black and red spectra show the dominant graphite peak (1) and very small diamond peaks (4, 7, and 8) for the film grown at 5 and 15 mm filament-substrate distance. The blue, brown and violet spectra show the dominant diamond peaks (4, 7, and 8) characteristic of high quality UNCD films; the green spectra shows a balanced mixture of graphite and UNCD phases.