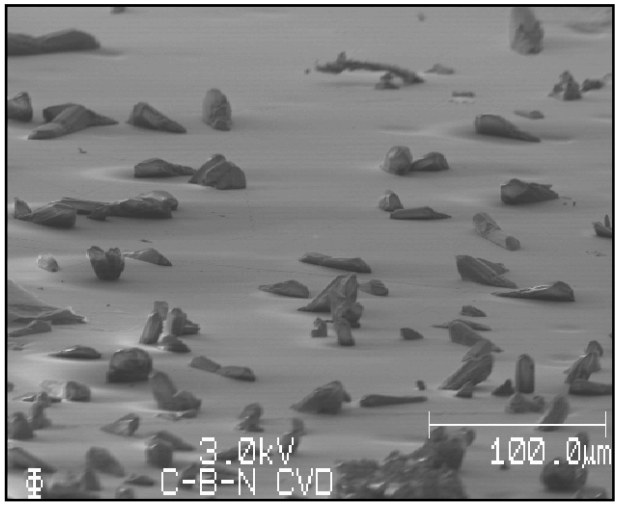
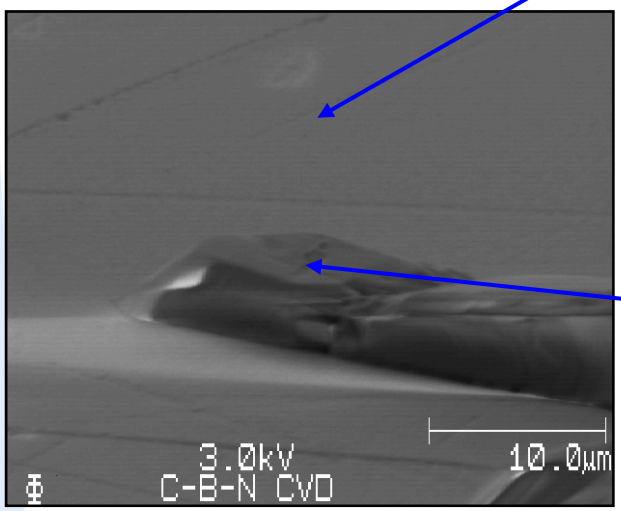
PHYSICAL ELECTRONICS
A DIVISION OF ULVAC-PHI

Auger Analysis of Boron Oxide Crystals Formed by CBN Chemical Vapor Deposition



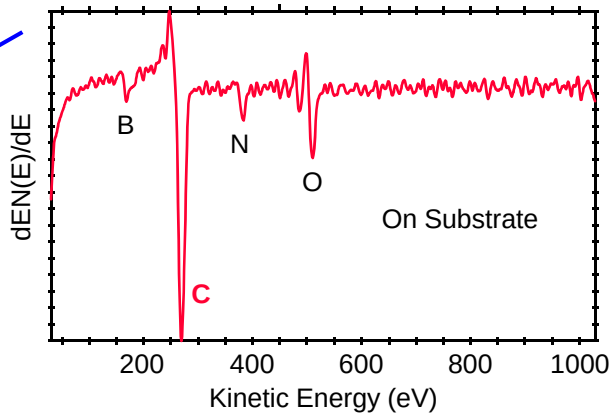
This low magnification secondary electron image of the CVD film shows extremely rough surface topography, with crystals protruding from the smooth surface.

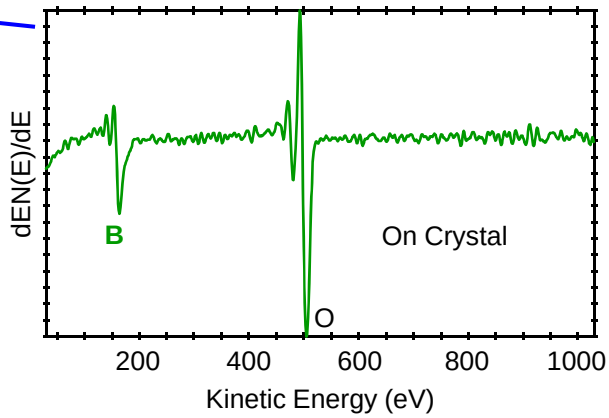


This higher magnification secondary electron image shows an individual crystal and the surrounding substrate.

An attempt was made to synthesize hard adherent films of cubic boron nitride (BN) or the hypothetical carbon nitride (C_3N_4) by chemical vapor deposition (CVD) of boron, nitrogen and carbon. The process was not successful, but instead resulted in small crystals protruding from a smooth surface.

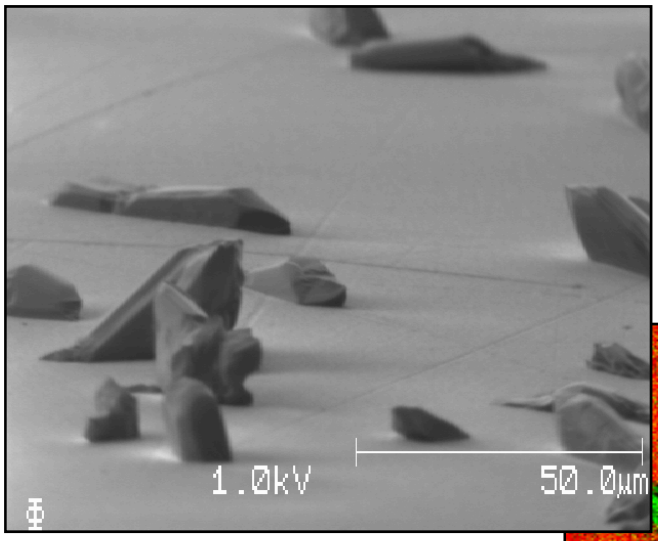
In order to better understand the reaction products, the sample was analyzed with a PHI 680 Scanning Auger Nanoprobe to determine the film and crystal composition. The sample was highly insulating, so the analysis was performed at a very high sample tilt (~80 degrees) and with a low primary beam voltage (1-3 kV). By adjusting sample tilt and primary beam voltage, the total secondary electron current can often be closely matched to that of the primary beam, producing a net current of zero to the sample and eliminating charging effects.



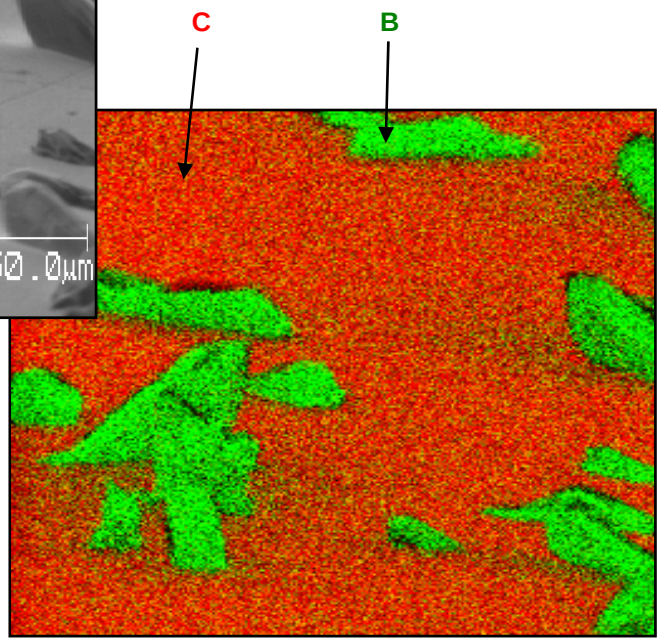


Auger spectra, obtained with a 3 kV primary electron beam, show that the crystal is a boron oxide and the smooth film is predominantly C, with small amounts of O, N and B.

A secondary electron image and Auger images of C and B were obtained with a 1 kV primary electron beam. These images show that the particles in the field of view have a high concentration of B.



Secondary electron image



Color overlay of Auger images
Red = C and Green = B

Analysis of samples with extremely rough surface topography is straightforward with the coaxial geometry of the Cylindrical Mirror Analyzer (CMA) and Schottky field emission electron column, even under conditions of extreme sample tilt. Data interpretation is unencumbered by instrument geometry or analytical shadowing complications.

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