

Quantitative phase identification and atomic structure analysis at interfaces in new C-BN multilayers

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Highly ordered carbon/BN with parallel stacking have already been synthesized with regards to basic graphene research by exfoliation-transferring methods [1],[2], that are unpractical for real applications. Therefore, there is a renewed interest in combined C/BN growth methods with large throughputs. The carbon/h-BN multilayers studied were obtained by the sequential ion-beam assisted-deposition (IBAD) of carbon and boron nitride in a vacuum chamber with a configuration described in [3]. Since both components present hexagonal structure with similar lattice parameters, it is interesting to study the formation of ordered super-lattices or, on the contrary, if distinct orientations are formed in each phase. In addition, if non-abrupt, gradual interfaces occur, the carbon/BN system keeps open the possibility of forming ternary BCN compounds.

Interestingly, in the structure-controlled series of C/BN multilayers, with bilayer thicknesses from 1.25 nm to 160 nm, BN and C basal planes of adjacent sub-layers exhibit perpendicular alignment between them: along the growth direction for h-BN layers, and parallel to the surface for the C ones [4]. Owing to the nanoscale of the samples, high resolution imaging performed in an image-corrected FEI Tecnai, and EELS conducted in a probe corrected Nion USTEM 100 (0.1 nm probe size), have been used to identify the structure and composition of the interfacial phases formed. Spatially-resolved Electron Energy Loss spectrum-images, have been analysed by new multivariate statistical methods that uses spectral unmixing algorithms [5]. The result is the extraction of base spectra representative of the different phases present, which allows a better understanding of the growth process.

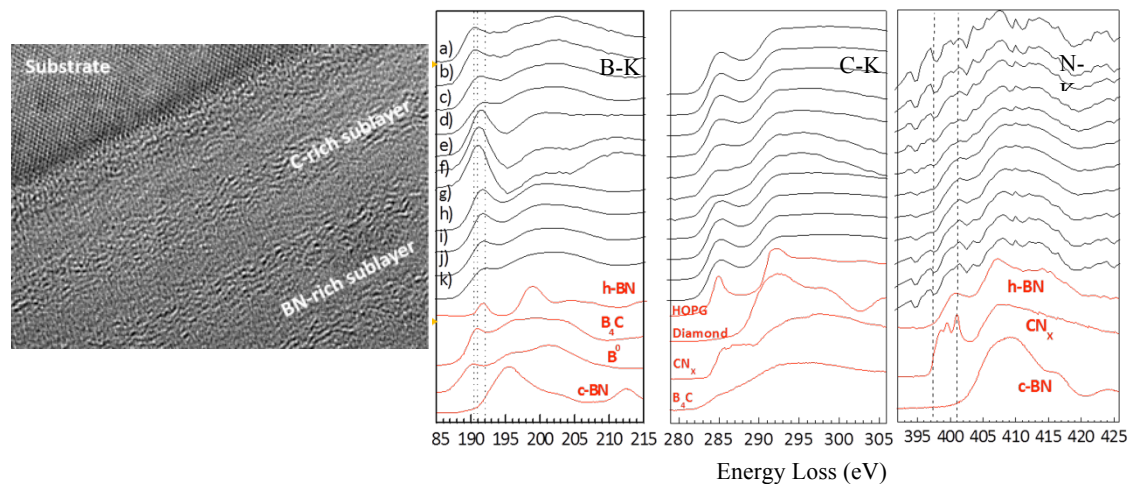


Fig. 1: Cross-sectional TEM image of a multilayer with nominal period of 5 nm; details of B-K, C-K and N-K extracted from different continuous areas of a spectrum-image, some reference spectra are shown for comparison

References

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