



ROBL-CRG

Experiment title:

Influence of dopant atoms in cubic boron nitride (c-BN) thin films on lattice parameters and intrinsic stress investigated by X-ray diffraction

Experiment number:

20_02_045

Beamline:

BM 20

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9

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Report:

First aim of this experiment was to study the reproducibility of the enlargement of cubic BN lattice constant by incorporation of Al. For this purpose a pure cubic BN and an Al-incorporated sample were measured. Secondly, the behaviour of a pure cubic BN layer on top of an Al-incorporated sublayer was investigated to study the influence of this sublayer on the biaxial stress value of the pure cubic BN-layer.

A preliminary study on such c-BN films revealed that the reflex of the (111) lattice planes is well pronounced, therefore this reflex was chosen to be studied. To obtain a great variety of different orientations of these (111) planes relative to the sample surface, a monochromatic beam of 1.1 Å was used. The angle between the incident beam and the sample surface was fixed at values of 0.3 ° (slightly above the angle of

external total reflection). To access differently oriented planes, the detector was moved either around a horizontal axis (2θ) or a vertical axis (2ω) while the remaining axis was held constant. The $\sin^2\Psi$ method (where Ψ is the angle between the vector normal to the lattice plane and the vector normal to the sample surface) was applied to analyze the biaxial stress state. Assuming a reliable value for the c-BN POISSON'S ratio from the literature, the spacing $d_0(111)$ of the unstressed lattice planes was obtained.

It comes out that the unstressed (111) lattice spacing of pure cubic BN depends on the preparation process. The relative enlargement of the lattice spacing due to Al incorporation remains nearly unchanged. As to the second study of the cubic BN layer on top of a Al-incorporated sublayer the contributions of the sublayer and top layer could not be resolved. The mean value of the lattice spacing lies between that of the pure cubic BN layer and that with incorporated Al described above.

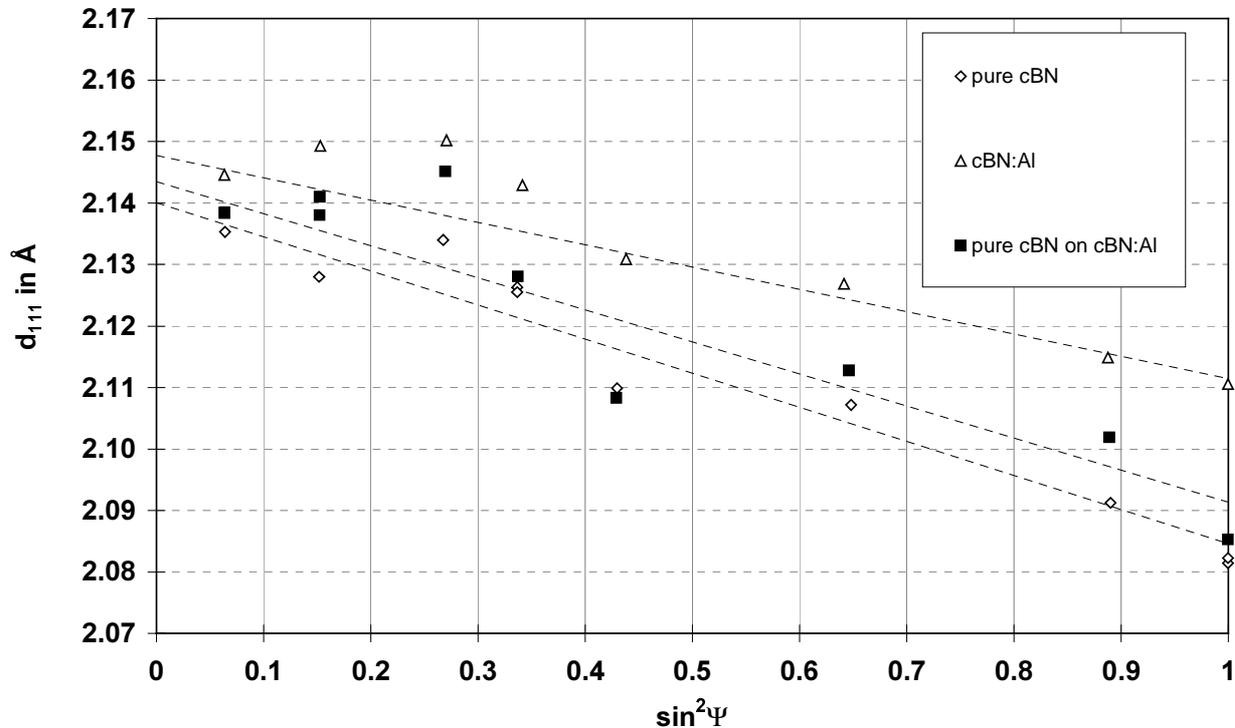


Fig. 1 Lattice spacing of (111) planes having different orientations with respect to the sample surface: a pure cubic BN layer, cubic BN layer with incorporated Al and a pure cubic BN-layer on top of a cubic BN-sublayer with incorporated Al