Micromechanical and Synchrotron based Techniques for Cross-sectional Investigations of Functional Thin Films

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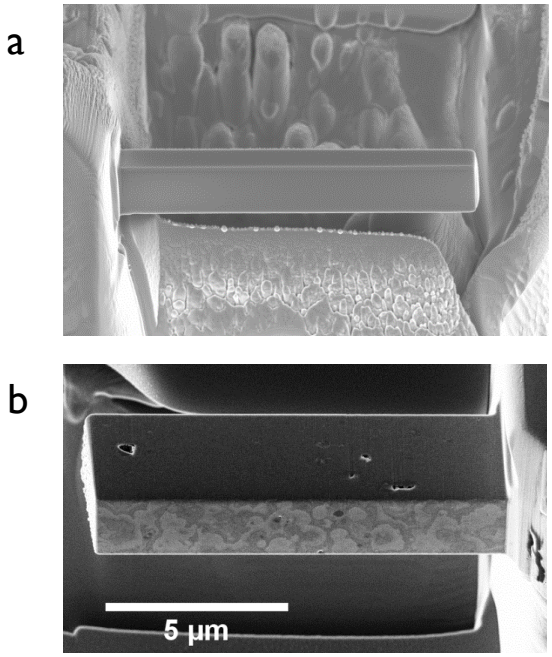
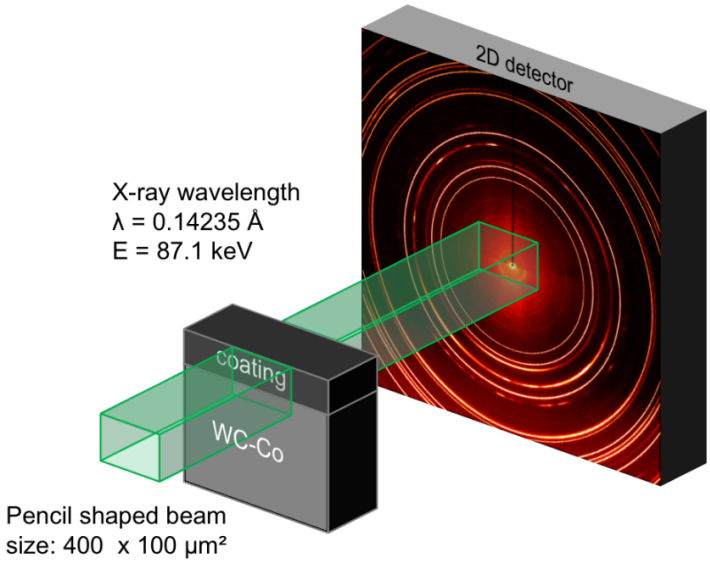
The knowledge-based development and improvement of advanced functional thin film systems and coating architectures, e.g. in nanostructured ceramic protective coatings for cutting tools, requires an in depth understanding of the underlying microstructure, composition, and physical properties on the micro scale. In particular, the combination of in-situ micromechanical testing techniques for accessing local mechanical properties (fracture toughness, fracture stress, Young's modulus) and synchrotron X-ray nanodiffraction (SXND), for investigating phase composition, texture and residual stress state, has proven to be a valuable strategy in the cross-sectional characterisation of nanostructured thin films. We will present specific application cases of thin film characterisation of (i) nano and polycrystalline CVD diamond, employing micro-cantilever testing of specimens prepared by focused ion milling (FIB) and SXND and (ii) AlCrN coatings, studied by in-situ dilatometry coupled with high-energy X-ray diffraction and in-situ micromechanical cantilever bending tests on FIB-milled specimens in as-deposited and annealed state. In addition, an outlook will be given on current work being performed at CEITEC nano.



Micro-cantilever specimens of PCD diamond (a) and AlCrN (b) for investigating mechanical coating properties



High temperature synchrotron diffraction experiment setup for studying thermal cycling and related phase transformations (b).