Cross-sectional X-ray Nanodiffraction Characterization of Radiation Damage, Stresses, and Microstructure in W Coatings

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A better understanding of depth-dependent radiation damage in protective coatings which can be used in fusion and fission reactors is essential pending step for further development of novel coating types and microstructures that are capable of withstanding severe environments over long time periods. Tungsten is a perspective material for plasma-facing components of a fusion reactor due to its high radiation resistivity, high thermal conductivity and high melting point. In this contribution, 8µm thick nanocrystalline tungsten coating on WC substrate with columnar microstructure was irradiated using Si ions with an energy of 5MeV with a fluence of $2x10^{16}$ ions/cm^2. In order to investigate depth-dependent changes in residual stresses and microstructure induced by the irradiation, cross-sectional X-ray Nanodiffraction (CSnanoXRD) with a beam size of 30nm was applied at European Synchrotron Radiation Facility in Grenoble, France, to scan 50µm samples at the film cross-section. The experimental results revealed significant changes in the depth-dependent gradients of residual stresses as well as with the changes in unstressed lattice parameters and the coating microstructure, which will be presented together with the data from transmission electron microscopy.