Morphology, microstructure and stress-state characterization of nanostructured tungsten

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Due to its properties: high melting point, low vapor pressure, low physical and chemical sputtering yields, low thermal expansion, electrical conductive properties and relative chemical inertness, tungsten seems to be one of the best candidates to be used as shielding material in plasma facing materials (PFM) for future nuclear fusion reactors. Nowadays, the capabilities of nanostructured materials for such applications are being attracted much attention due to their radiation-resistant and self-healing behavior.

In this work, we report on the growth of nanostructured W (nW) coatings in wide range of thickness varying from 3nm up to 4□m by using DC magnetron sputtering on different kind of substrates (Si and steel). The steel substrate was selected due to the interest for possible industrial applications. For that reason, the substrate influence on sample morphology and microstructure was also investigated. Transmission electron microscopy (TEM) and X-ray diffraction (XRD) illustrate that coatings are pure α-W phase polycrystalline and present a compressive total residual stress and low micro-strain. SEM images show that coatings consist on nano-columns with an inverted pyramidal shape which growth perpendicular to the surface substrate.

The results reveal that morphology, microstructure and micro-strain for nW deposited on Si and on steel are pretty similar.