Fabrication of nanocolumnar structures by oblique angle sputtering

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Coatings based on nanocolumnar structures are used in diverse applications such as sensor technology, photovoltaic cells, magnetism, optical devices, electrochemistry, energy and catalysis.

Traditional methods to fabricate these nanocolumns are self-assembly and lithography. However, these methods are often complex and expensive and therefore, do not completely fulfill the market requirements that demand the use of simple, low-cost, environmentally friendly and easily scalable methods.

One way to satisfy these demands is to fabricate coatings with nanocolumnar morphology by using sputtering techniques in the oblique angle (OAD) configuration. In addition, the use of this technique allows optimizing both, the morphology as well as the elemental composition of the nanocolumns, for a particular application. This is done by tuning the sputtering parameters such as working gas pressure, distance between the target and the substrate, substrate temperature, voltage applied to the cathode, deposition angle, rotation of the substrate and mixtures of the working gases (in reactive sputtering).

In this talk, we will show the capabilities of OAD sputtering to fabricate nanoolumnar structures and the influence of the sputtering parameters on the morphology and on the elemental composition of the deposited nanocolumns. We will also show ongoing work carried out at the Institute of Nuclear Fusion related to this topic.

Finally, we will present several examples related to: (i) the ability of Au plasmonic nanostructures to confine large electromagnetic fields on nanometric volumes; i.e., the so-called hot spots, which is very relevant for several applications such as like surface-enhanced spectroscopies [1] (ii) the radiation behavior of tungsten nanocolumns and their capabilities to be applied as plasma facing materials in future nuclear fusion reactors [2].

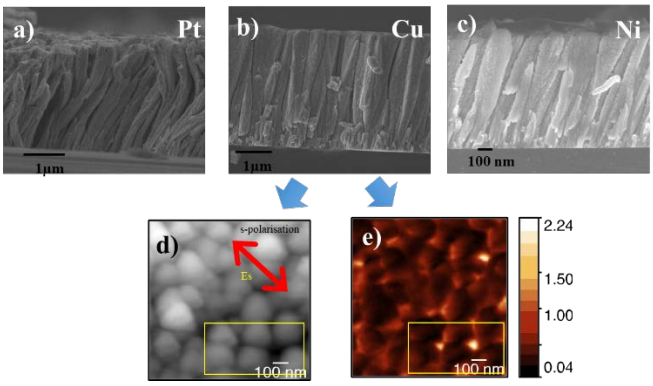

Figure 1: *Cross sectional scanning electron microscopy images for three different nanocolumnar coatings: Pt (a), Cu(b) and Ni(c). Topography (d) and scanning near-field optical microscopy images for the Cu samples(e).*

Index Terms: nanocolumns, oblique angle sputtering, radiation resistant, plasmonic.

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