POC013

Growth of nanocolumnar thin films on patterned substrates at oblique angles

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Nanocolumnar porous thin films deposited at oblique geometries are nowadays receiving much attention due to their unique morphological features and remarkable properties. From an experimental point of view, porous nanocolumnar thin films have been classically grown by evaporating a given material in vacuum and promoting the glancing incidence of gaseous deposition species onto a tilted substrate, in a so-called Glancing Angle Deposition. The magnetron sputtering technique operated at oblique angles (MS-OAD), has emerged as one of the most interesting procedures in terms of efficiency, reliability, reproducibility, and potential industrial scalability. The variety of typical porous morphologies that can be achieved by the magnetron sputtering technique operating at oblique angles (MS-OAD) is rich, allowing the customization of film nanostructures with optimum performance for numerous functional applications. However, to our knowledge, there are important unexplored conditions that require further study and that might widen the possibilities of the method even more. In this work we have analyzed the influence of substrate patterns on the nanocolumnar development of thin films grown by magnetron sputtering at oblique angles. A critical thickness has been defined, below which the columnar growth is modulated by the substrate topography, while for thicknesses above this value, the impact of substrate features is progressively lost in two stages; first columns grown on taller features take over eighbouring ones, and later the film morphology evolves independently of substrate features. These results have been experimentally tested by analysing the nanocolumnar growth of SiO_2 thin films on ion-induced patterned substrates.

Keywords
magnetron sputtering
nanostructures
oblique angle deposition
patterned substrate
thin films