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Nano structured thin films by GLAD: a simulation approach

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The glancing angle deposition (GLAD) [1] technique has been proved to be a very efficiently and prodigal method to grow nanostructured thin films. It involves a mobile and oriented substrate against the source of atoms, jointed to a columnar growing mode. By controlling the two rotations, along the normal and in the plane of the substrate, complex separated structures can be produced. The combination with a patterned substrate leads to extended possibilities. Such films present a wide range of particular behaviour, which have to be investigated. Simulation appears to be a powerful approach to predict the growth processes, the pattern dimensions and some physical properties.
In this study, the Monte Carlo procedure is involved. The simulation is structured in three main parts. The first one concerns the lattice surface defining the substrate. The initial topography is either smooth or periodically patterned by the user. The second part is focused on the ballistic conditions and the final desired architecture. The number of vapour sources, the incident angle of the vaporised atoms, the substrate rotation, and the transport of the atoms in the chamber are taken into account. Last but not least are the diffusion settings of the particles impinging on the substrate surface and/or the growing film. Diffusion's energy, directions, temperature, sticking conditions and kind of diffusion are the parameters, which are mainly assumed. Post-procedure offers a wide choice of calculations (density, roughness, surface topography...) and viewing possibilities, which allows checking physical meanings of the simulation.
This work reports on simulations of thin film growth exhibiting oblique, zigzag and spiral columnar microstructure. A single vapour source is involved and the angle α of the incident particles as the angle φ of the substrate rotation is controlled and correlated with each structure. Thus, the surface roughness, density and microstructure of the films are considered and compared with experimental measurements. Some simulations based on films presented in the literature are also presented.
[1] K. Robbie and M.J. Brett, J. Vac. Sci. Technol. A13 (1995) 1460.

Keywords
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