PROPERTIES OF METALLIC THIN FILMS GROWN ON PERIODICALLY CORRUGATED SURFACES

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Nanostructured thin films are of growing relevance for all kind of applications in photovoltaics, plasmonics, or as magnetic materials. Various methods have been used to fabricate nanostructured thin films with well defined morphology exhibiting tunable effective properties. Bottom-up, self-organized methods have been used extensively in the last years because of their fast and easy way of producing large-scale patterns with structures down to 10 nm.
Ion beam sputtering has proven to be a promising way to produce self-organized patterns on various surfaces [1]. Depending on the ion beam incidence angle, hexagonally ordered dot patterns as well as ripple patterns oriented perpendicular or parallel to the ion beam direction are formed during the continuous sputtering. Periodically corrugated surfaces can also be obtained via crystal surface reconstruction during annealing. The resulting surfaces provide templates for the growth of nanopatterned thin films. Depending on the surface and interface free energies these films can grow in a conformal way reproducing the surface topography or as nanoparticles on the substrate surface. Furthermore, depending on deposition angle, substrate temperature, beam flux, and deposition time, the nanoparticles can align parallel to the ripples, eventually coalescing and forming nanowires, thus tuning the physical properties of these structures via their geometrical dimensions.
Metal thin films grown in this way exhibit distinct optical properties due to localized surface plasmon resonance. Due to their alignment along the ripple structures the nanoparticles exhibit strongly anisotropic plasmonic resonances [2]. Furthermore, the magnetic properties of ferromagnetic thin films grown on rippled or faceted substrates are drastically changed by the presence of the periodic structures at the interface and on the surface [3].

Keywords: metallic thin films; magnetic properties; optical properties; surface plasmon resonance

References

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