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Growth of obliquely deposited nanostructured Ti thin films

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Highly porous, nanostructured metallic thin films are interesting for numerous applications such as electrodes in fuel cells and Li-ion batteries as well as for surface enhanced Raman sensors and implants. Combining electron beam evaporation and oblique angle deposition (OAD) represents an elegant and powerful technique to sculpture manifold surface morphologies on the nanometer scale. Thereby, the substrates normal is tilted to a highly oblique angle θ with respect to the incoming particle flux. Due to the oblique deposition geometry, shadowing is induced during the growth process so that a thin film consisting of separated tilted nano-sized columns is formed. Rotating the substrate changes the growth direction of these columns, which allows the creation of nano-sized screws, spirals or chevron structures, for instance. The precise control of surface morphology plays a key role for tailoring many film properties. During the last decades, mainly insulating and semi-conducting OAD structures have been in the focus of research activities, but the knowledge about the growth process of metallic OAD structures still remains incomplete. However, the angle of the incoming particle flux θ and the substrate temperature TSub have already been identified as parameters that influence the growth of such columns significantly. The experimental setup allows varying the incidence angle θ between 0° ≤ θ ≤ 90° and the substrate temperature T_{Sub} between 77 K ≤ T_{Sub} ≤ 1000 K. The presentation concentrates on the microstructure, texture and morphology of nano-sized Ti columns depending on these parameters. Natively and thermally oxidized Si(100) pieces were used as substrates. During deposition, the working pressure in the vacuum chamber was constant at 10⁻⁷ Pa. Analysis was carried out using X-ray diffraction in-plane pole figure measurements, scanning electron microscopy and high-resolution transmission electron microscopy.

Primary author: Ms LIEDTKE-GRÜNER, Susann (Leibniz Institute of Surface Engineering (IOM))

Co-authors: Mr GRÜNER, Christoph (Leibniz Institute of Surface Engineering (IOM)); Dr GERLACH, Jürgen W. (Leibniz Institute of Surface Engineering (IOM)); Dr LOTNYK, Andriy (Leibniz Institute of Surface Engineering (IOM)); Prof. RAUSCHENBACH, Bernd (Leibniz Institute of Surface Engineering (IOM))

Presenter: Ms LIEDTKE-GRÜNER, Susann (Leibniz Institute of Surface Engineering (IOM))

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