Nanocomposites and nanomaterials

Synthesis of one-dimensional metallic and carbon structures under near-equilibrium deposition conditions

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It is generally accepted to represent all experimentally obtained sorts of film structures in the form of SZMs (structure zone models). SZMs show how the film structure varies with technological deposition parameters, such as substrate temperature and ambient pressure or energy delivered to the growing film. According to SZMs the films are usually predicted to have solid structure after prolong deposition, and the only region of any spatial porosity-like feature relates to porous defective unstable structures at the lowest temperatures and energies.

We offer to take into account deposition rates (or supersaturation) and show experimentally on example of various metals and carbon [1-4] that prolong deposition can result in formation of highly porous films, and particular, those consisting of one-dimensional crystals, fibres, whiskers and probably nanotubes (when depositing carbon). This happens when depositing under near-equilibrium conditions. The technology used is based on modified dc magnetron sputterer with hollow cathode, which features atom-by-atom forming the layers' architecture at interdependent dissipative self-organization of low supersaturations and conservative self-organization of structures on a substrate. Usually the 1D-structures form a developed highly-porous network, and when a negative bias is applied to a substrate, they are oriented strictly perpendicularly to it.

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