Investigating thin-film growth atom by atom

Project Lead:
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Epitaxial Thin-Film Growth

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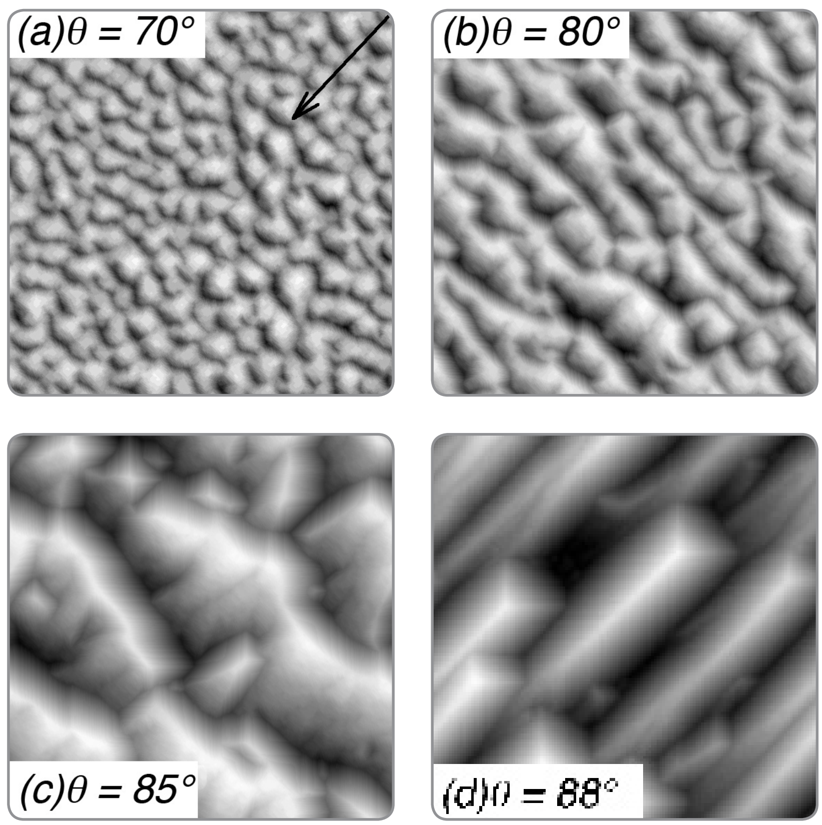
Among several interests studied by University of Toledo physicist Jacques Amar, Ph.D., are the processes behind epitaxial thin-film growth, in which the crystals of the film are aligned with the underlying material.

Thin-film structures can range from fractions of a nanometer to several micrometers in thickness and are used to make semiconductors and solid-state lasers, as well as a variety of other nanostructures such as quantum wells, quantum wires, and quantum dots. These structures are vital in the hybrid microelectronics, microwave, semiconductor, optical, medical, sensor, and related industries.

One of the simplest methods for arranging the atom layers, called Molecular Beam Epitaxy (MBE), enables scientists to create nanostructures by controlling how the thin-films are deposited on a surface. However, neither MBE nor a variety of more complex methods used to grow thin-films is well understood.

Using supercomputing resources provided by the Ohio Supercomputer Center, Dr. Amar is developing methods to simulate thin-film growth and other non-equilibrium processes over extended time and length scales.

"By carrying out simulations starting from the atomic scale, but ranging up to the micron or sub-micron length-scale, I hope to obtain a fundamental understanding of the key factors and processes which determine thin-film properties," Dr. Amar explained.



Gray-scale pictures of surface morphology obtained from simulations of metal epitaxial growth with different deposition angles θ with respect to the surface normal. The arrow indicates direction of deposition beam. The research was published in *Physical Review Letters*, Volume 98, 2007.