NANO HIGHLIGHT
"Shadowing Growth of Uniform 3D Nanostructures"
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Our multidisciplinary project focuses on the growth of three-dimensional nanostructures in the form of rods, beams, and helical springs, by using an oblique angle deposition technique. The physical properties of these as grown nanostructures have been measured. This deposition technique is a physical self-assembly method based on the shadowing effect during thermal evaporation or sputter deposition of atomic species onto a flat or templated substrate. These nanostructures with controllable nanometer scale dimensions cannot be made by advanced lithographical techniques such as electron-beam or X-ray lithography. The fact that these structures can be integrated onto a substrate platform makes them very attractive for a wide variety of potential applications in the area of nanomechanics, nanoelectronics, and nanophotonics. Many sensors, actuators, and dampers built from these nanostructures are expected to possess dramatically better performance than that of conventional devices.

One of the challenges in shadowing growth of 3D nanostructures on a templated substrate with regular arrays of seeds is that it gives rise to a phenomenon referred to as "fan-out" growth in that the size of the nanostructures overgrows along the direction perpendicular to the incident deposition flux. The net result is that the size of the nanostructures cannot be controlled as they grow. Recently we have employed a back-forth substrate swing rotation method to overcome the "fan-out" growth. By using this method, uniform nanostructures such as nanorods and nanosprings were fabricated on templated substrates. The figure shows such an example. These structures have potential applications in NEMS (nanoelectromechanical systems) and nanophotonics.

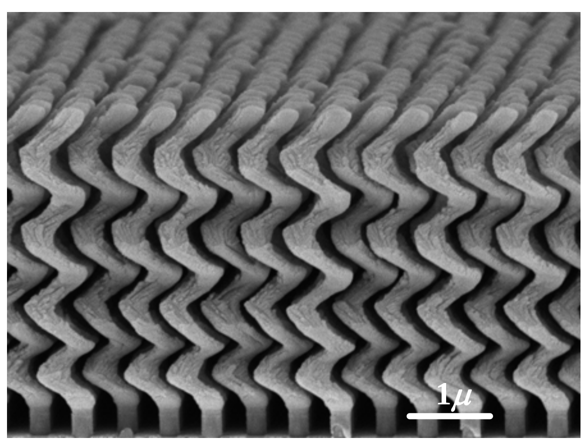

Figure caption: This figure shows a cross-sectional scanning electron micrograph of Si square nanosprings (four arms) grown on nanoposts arranged in a triangular lattice. Each arm of the nanosprings is grown at an incident flux angle of 85° with respect to surface normal and a swing angle of 60^{o}. The white scale bar represents $1\mu m$. This spring structure has the symmetry similar to that of a diamond lattice and has a photonic bandgap property that can be used to manipulate light.