title	Synthesis and Characterization of 1D piezoelectric nanostructures for resonating applications
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department	Materials Engineering (MATE)
proj_desc	Nanotechnology Research: Union between top-down and bottom-up assembly is required for scaling down physical, chemical and biological sensors and probes. Current sensor/probe-based technologies are firmly founded on top-down manufacturing with limitations in cost of production, manufacturing methods, and material constraints. As an alternative to such limitations, I propose the integration of one-dimensional, piezoelectric, nanostructures with contemporary fabrication methodologies for high frequency applications. Devices under investigation will exploit the unique size, geometry, crystallographic orientation, and piezoelectric behavior of individual, single-crystal nanostructures. With dimensions ~35-1800 times smaller than conventional cantilevers and beams, nanostructures are expected to have improved physical, chemical, and biological sensitivity. In order to accomplish these long term goals, two major milestones must be developed in parallel in the near term. The first milestone is to ascertain specific growth directions of piezoelectric materials during synthesis. Evaporative parameters such as pressure, oxygen concentration, impurity concentration, ramp-rate and source/substrate temperatures will be investigated. This research is necessary because many nanostructures are anisotropic single-crystals, and therefore, their physical properties are directly related to the direction in which they grow. The second milestone is to grow individual nanostructures site-specifically, with crystallographic-specific orientation onto a non-epitaxial substrate. This research is required to package individual nanostructures into existing MEMS devices without altering process flows. Once the materials have been synthesized in a controlled fashion, the individual nanostructures will be incorporated into a diversity of device applications that include resonators, filters, gravimetric sensors, and AFM tips. Clamped-free cantilever, bulk acoustic wave (BAW), film bulk acoustic resonator (FBAR), and surface acoustic wave (SAW) designs will be investigated in the future. Zinc oxide, a common material from which nanostructures are synthesized, is chosen because of its large piezoelectric effect and biocompatibility. For additional information on prior research within this field, please don't hesitate to contact me at the information enclosed in this package.
inter_desc	Working in conjunction with UCSB, this project will leverage a team of students with an interest in synthesis, characterization, and electrical measurements.
links	
students	4
majors	MATE, CHEM, EE
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