Thin Film Piezoelectric Energy Scavenging Systems

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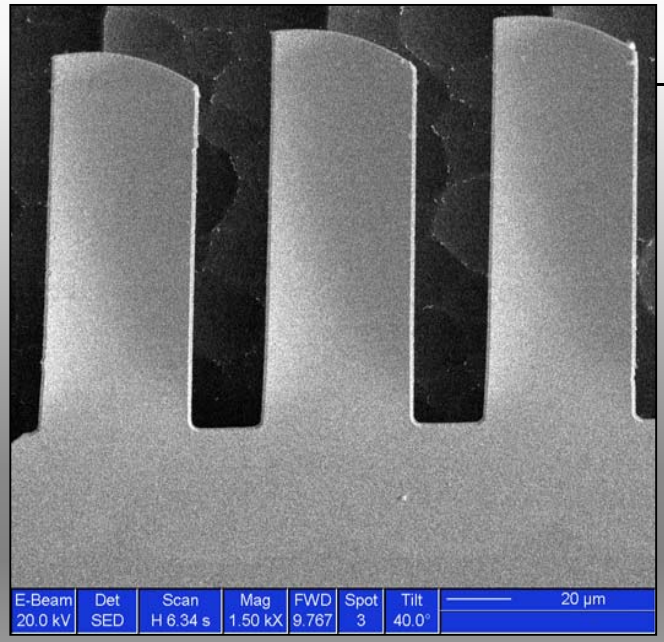
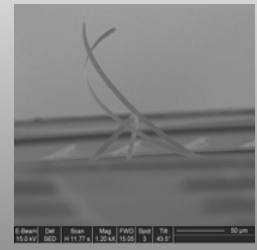


Vision

For small, inexpensive, ubiquitous wireless sensors to be realized, all constituents of the device, including the power source, must be directly integratable. The apparent solution lies in the growth and direct integration of piezoelectric thin film unimorphs with the wireless electronics. The requirement for all growth, fabrication, and integration steps to utilize standard fabrication techniques necessitates the use of silicon wafer substrates and fabrication process.

Research Questions



Can single crystalline PZT be grown on silicon?

Is it possible to use standard microfabrication processes to create and microcantilever array?

How to compensate for the high residual stresses?

What kind of output power is expected? Is this sufficient to power the wireless sensor node?

Methods

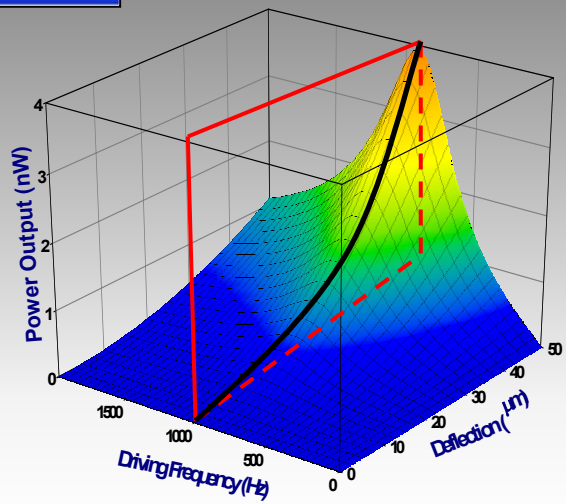
Pulsed laser deposition used to deposit epitaxial PZT on Si substrate

Low stress metallic elastic layer deposited through electron beam evaporation

Features defined through photolithography and ion milling

Cantilevers release through isotropic XeF_2 gaseous etch

Testing to be conduction in collaboration with BSAC using Laser Doppler Vibrometer



Findings

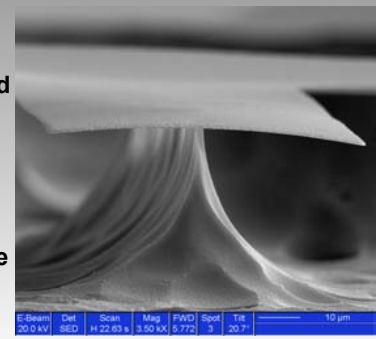
Conservative modeling suggests power generation per cm^3 is approximately 200 µW

Piezoelectric properties of PZT on Si substrate have been tested and optimized

Fabrication of cantilever array using standard fabrication processes successful

Cantilever arrays are ready to be tested for power output

Alternative design are being developed to improve robustness of scavenging system



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