Bioinspired Acoustic Particle Velocity Sensor

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Primary CNF Tools Used: LPCVD silicon nitride deposition

Abstract:

Inspired by the velocity-sensitive ears of small animals [1, 2], vector acoustic sensing using viscous-driven mechanical structures is emerging as a promising alternative to traditional pressure-based sound detection. We have performed silicon nitride deposition using CNF, which serves as the structural layer for forming slender microbeams used in bioinspired acoustic particle velocity sensing. This vector sensing approach overcomes fundamental limitations of scalar pressure-based acoustic sensors, offering intrinsic advantages in directional sound detection, source localization, and noise rejection.

Research Summary:

We used CNF facilities for silicon nitride deposition on double-side- polished wafers. The deposited silicon nitride served as the structural layer for fabricating slender microbeams designed for bioinspired acoustic particle velocity sensing.

Conclusions and Future Steps:

We successfully fabricated slender silicon nitride microbeams (Figure 1) based on the deposition work performed at CNF, which are currently being characterized for their performance in acoustic particle velocity sensing. As a next step, we plan to use the Nanoscribe 3D printer at CNF to fabricate 3D microstructures on the silicon nitride beams. These structures aim to enhance acoustic performance by mimicking the 3D geometry of mosquito antennae, which are capable of detecting extremely weak sounds.

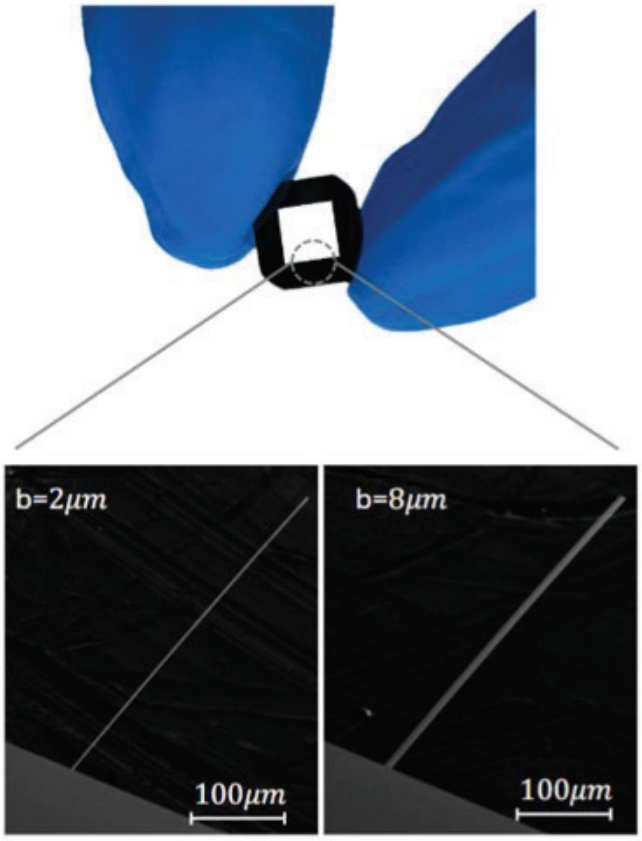

Figure 1: False-color scanning electron microscope image of a diffractive robot, consisting of (yellow) ALD silicon oxide hinges, (red) programmable cobalt nanomagnets, and (blue) rigid silicon oxide panels.

References:

[1] Zhou, Jian, Junpeng Lai, Gil Menda, Jay A. Stafstrom, Carol I. Miles, Ronald R. Hoy, and Ronald N. Miles. "Outsourced hearing in an orb-weaving spider that uses its web as an auditory sensor." Proceedings of the National Academy of Sciences 119, no. 14 (2022): e2122789119.

[2] Pantoja-Sánchez, Hoover, Brian C. Leavell, Bianca Rendon, WA Priyanka P. de-Silva, Richa Singh, Jian Zhou, Gil Menda et al. "Tiny spies: mosquito antennae are sensitive sensors for eavesdropping on frog calls." Journal of Experimental Biology 226, no. 24 (2023): jeb245359.