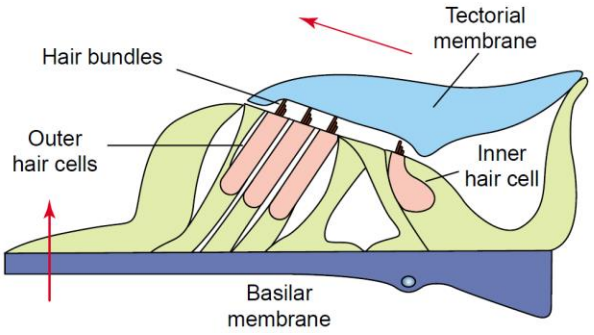
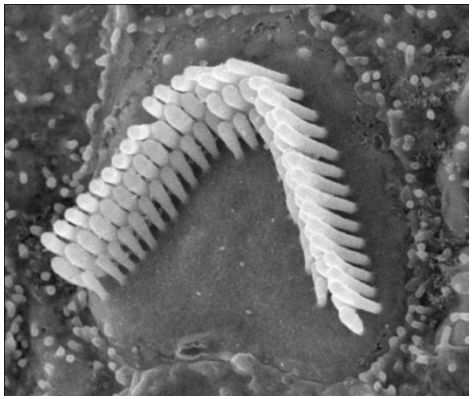
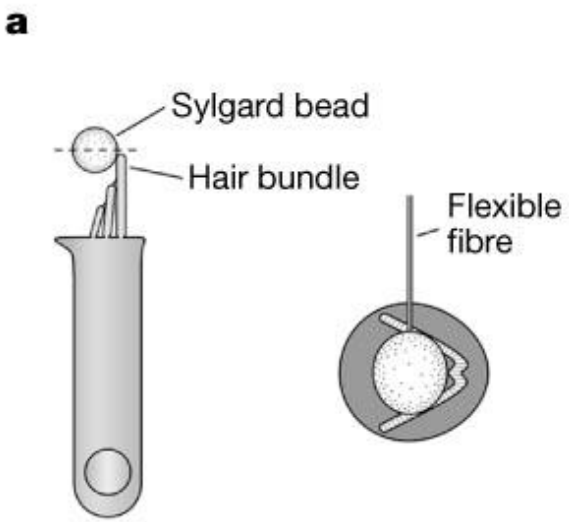
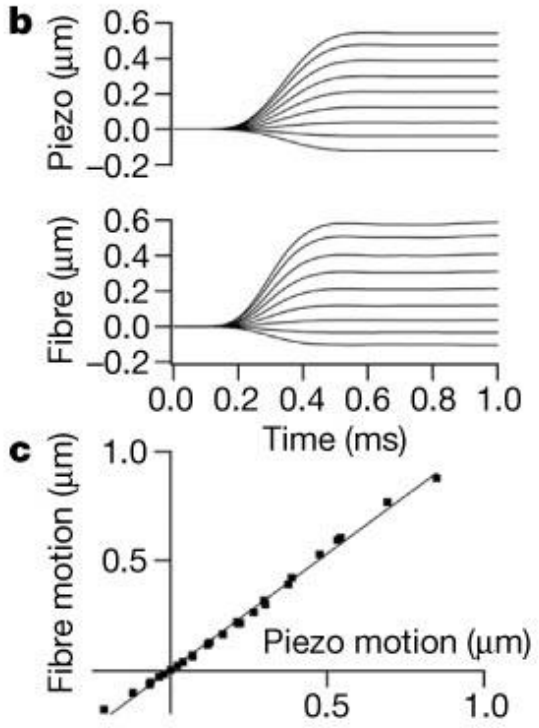
Application: Cochlear Hair Cell Mechanics



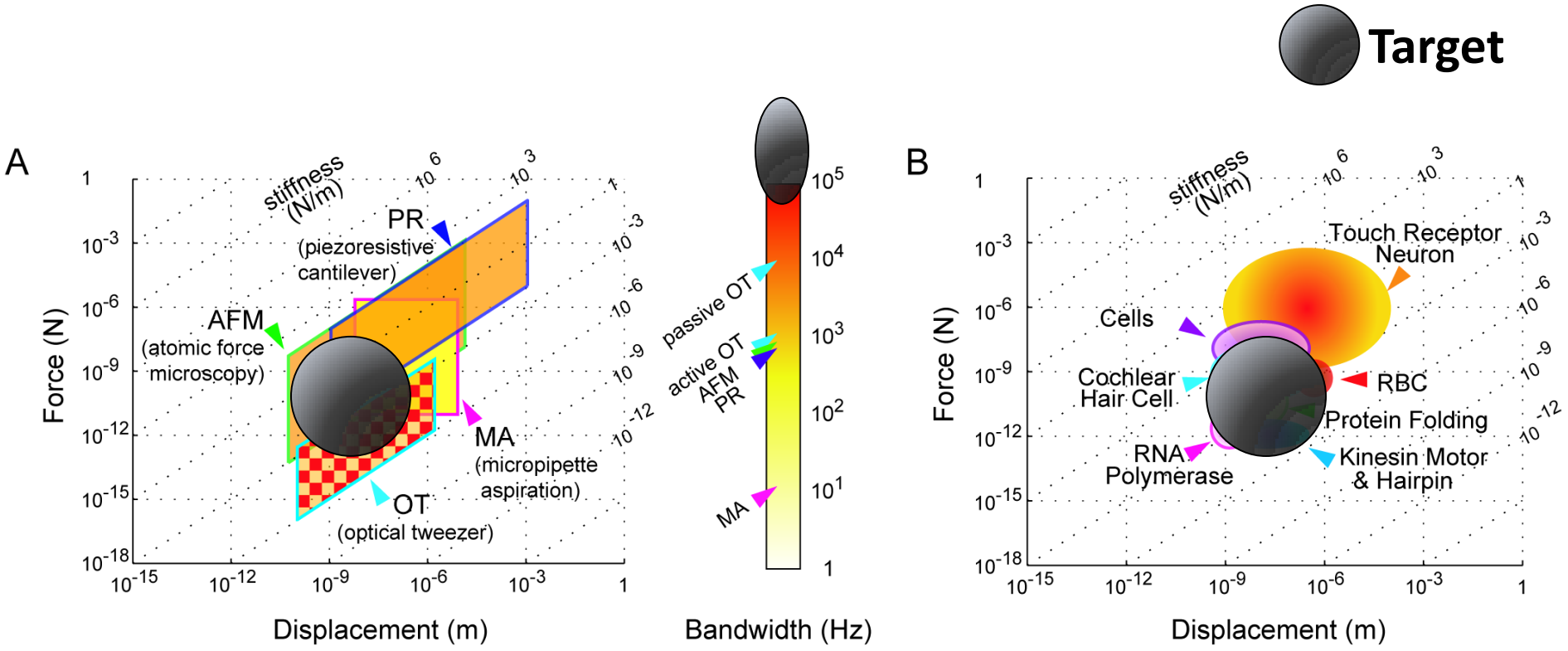






Current Limits:
Flexible fiber: 1kHz, 1mN/m
Stiff fiber: 5-10kHz, >50 mN/m

Performance Goals

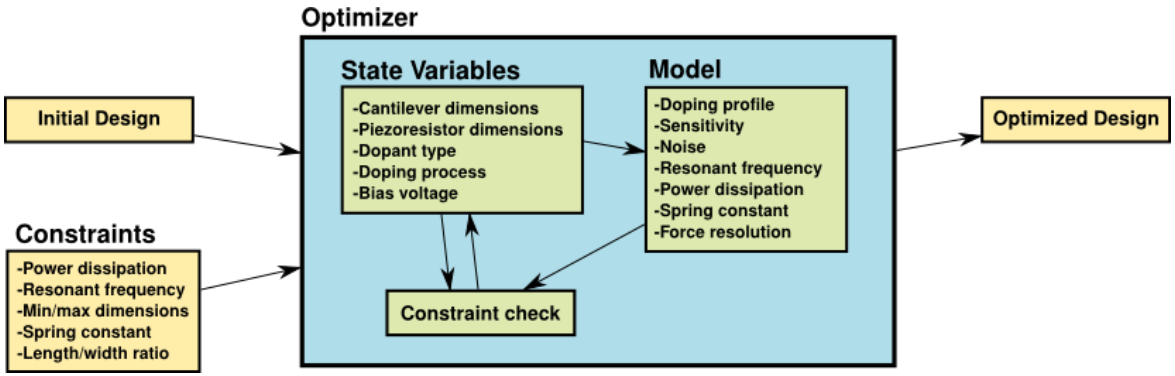


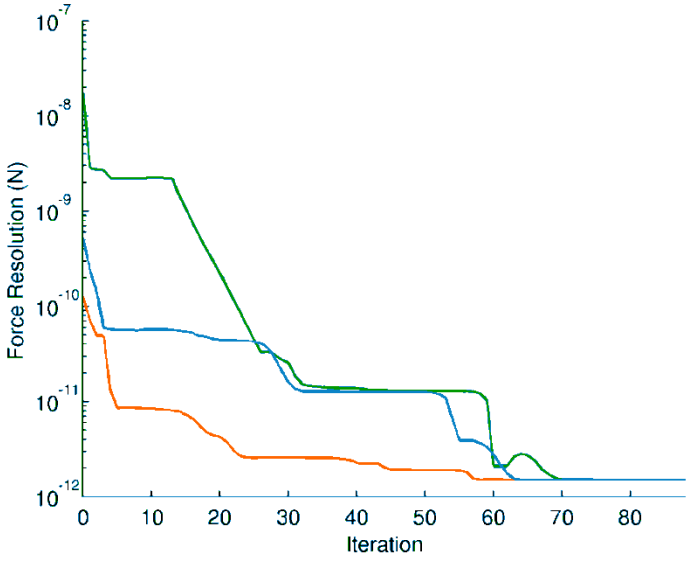
Building blocks:

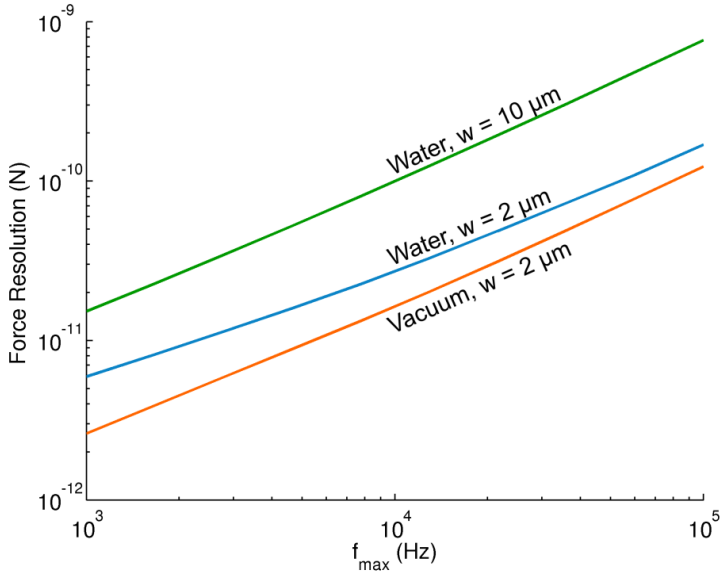
1) Sensor bandwidth and resolution
2) Actuator speed

Adapted from Park et al, PNAS 2007

Sensor Design Optimization

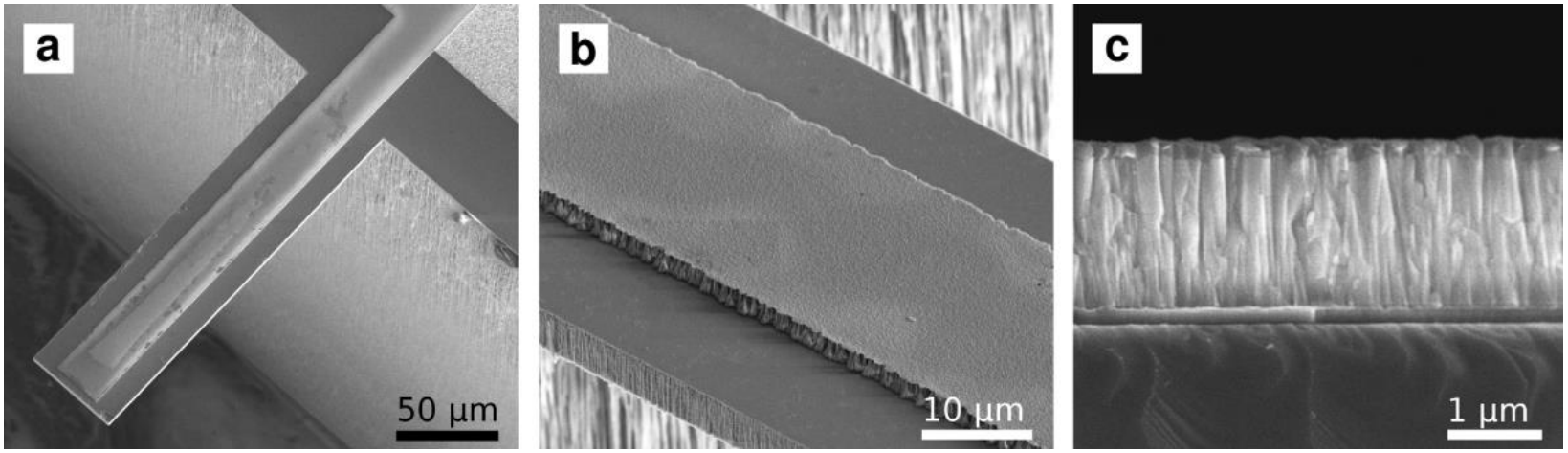


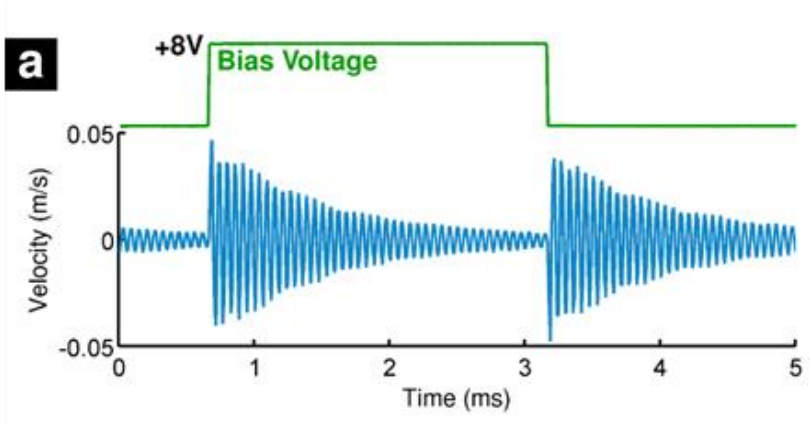


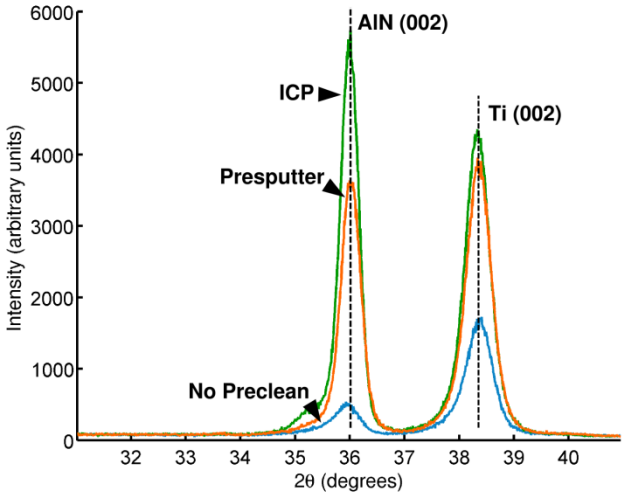


JC Doll, S-J Park, BL Pruitt
"Design optimization of piezoresistive cantilevers for force sensing in air and water"
Journal of Applied Physics (2009)

Piezoelectric Actuation







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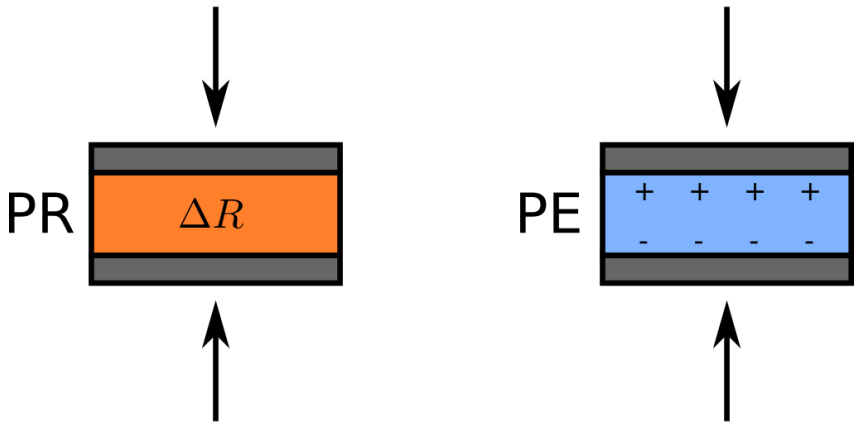
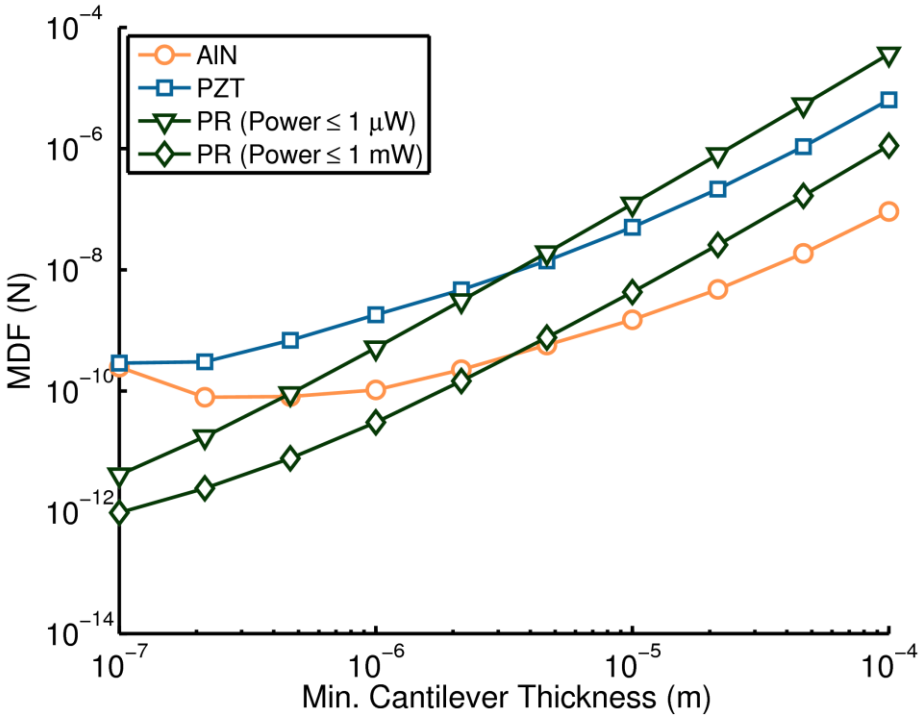
"Aluminum Nitride on Titanium for CMOS Compatible Piezoelectric Transducers",
Journal of Micromechanics and Microengineering (2010)

Piezoresistive vs. Piezoelectric Sensing and Power Dissipation Effects





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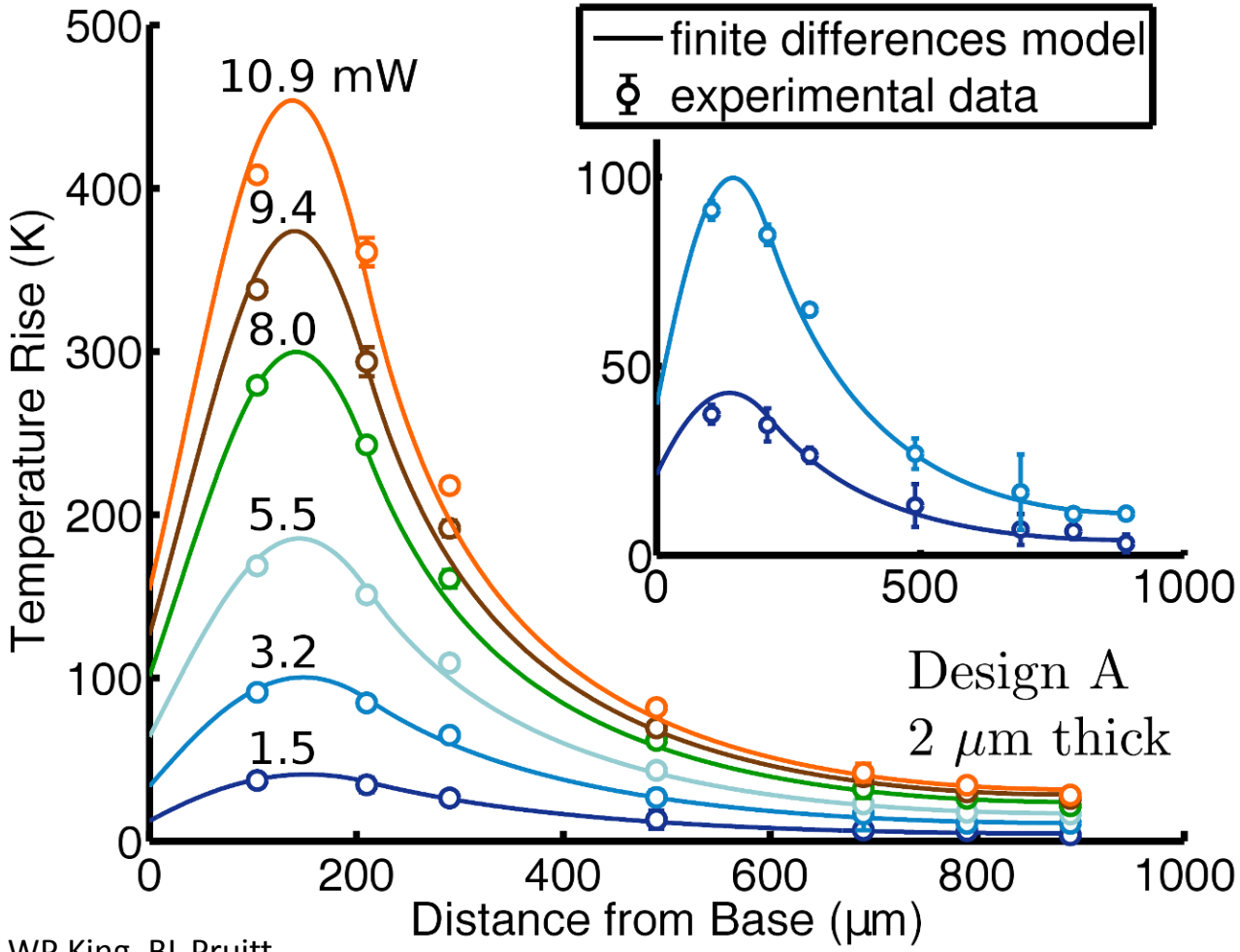
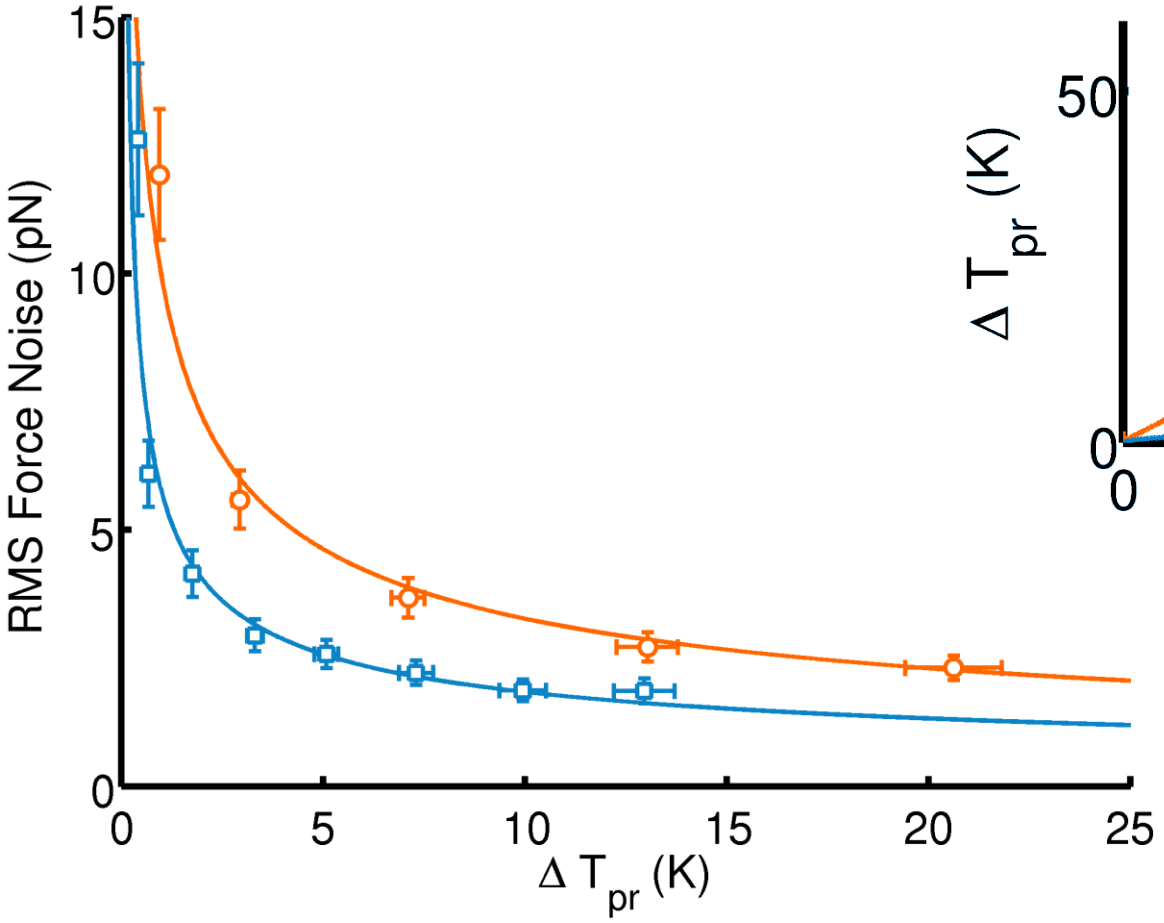
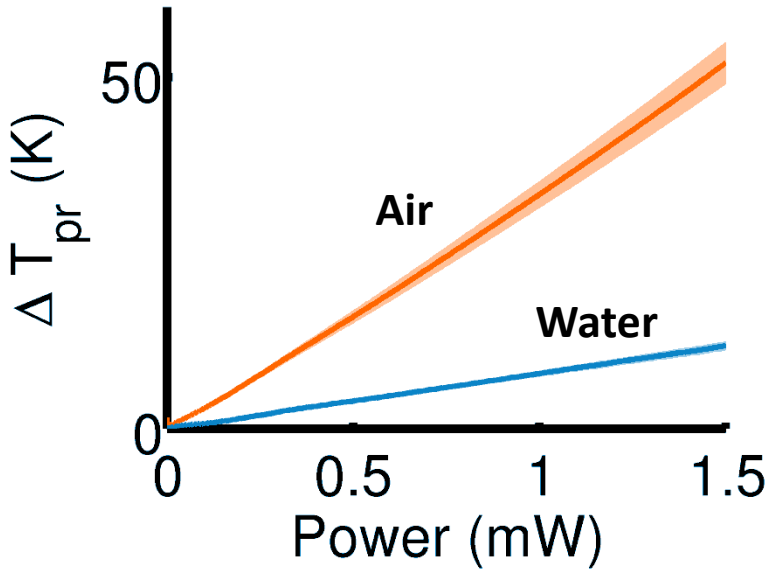
A Piezoresistor Self-Heating Model



JC Doll, EA Corbin, WP King, BL Pruitt,
"Self-heating in piezoresistive cantilevers",
Applied Physics Letters, in review

Water Operation Improves Resolution





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Applied Physics Letters, in review