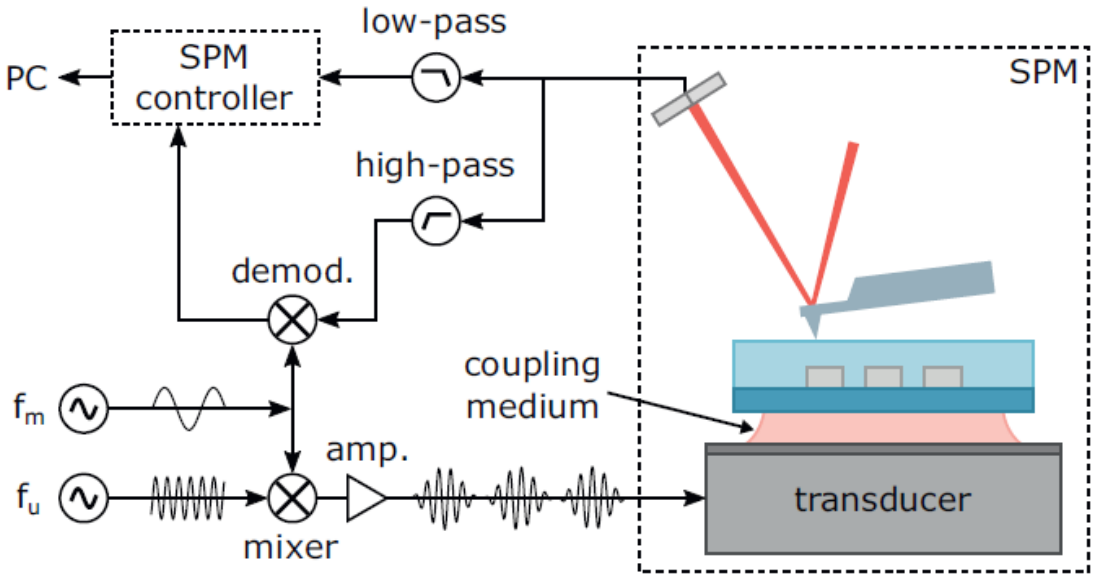
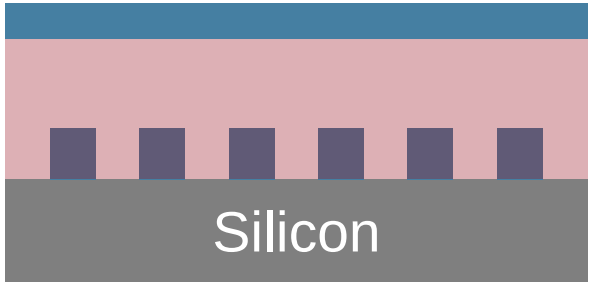
IMPROVED SUBSURFACE AFM USING PHOTOTHERMAL EXCITATION

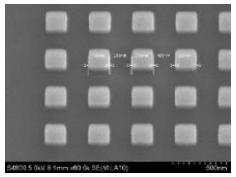
Aliasghar Keyvani, Maarten E. v. Reijzen, Mehmet S. Tamer,
Maarten H. v. Es, Martijn v. Riel, Hamed Sadeghian, Marco v. d. Lans

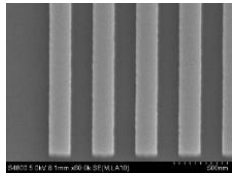
NOMI, TNO, Delft, The Netherlands

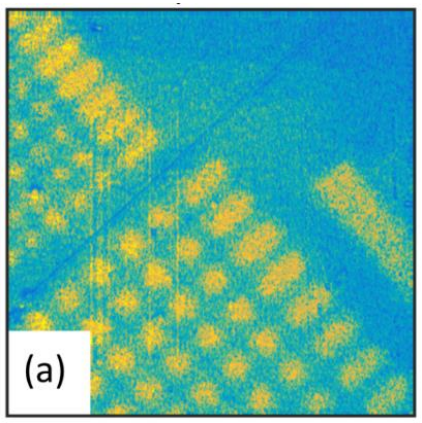
SUBSURFACE SCANNING PROBE MICROSCOPY



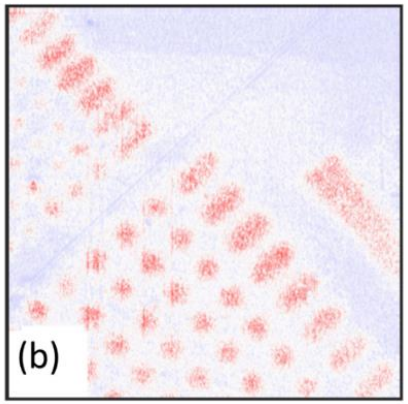








Amplitude



Phase

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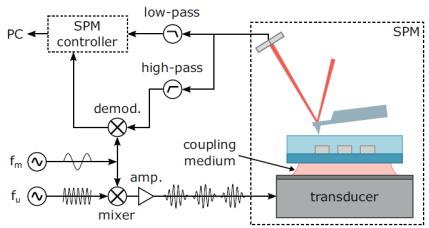
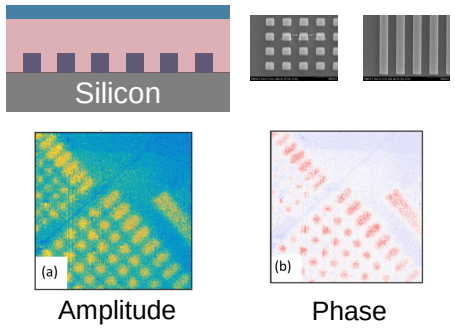
OUTLINE

- Quantifying SPM
  - contrast mechanism
  - measurables
- Photothermal actuation
- Improved cantilevers
- Frequency tracking
- Conclusions

QUANTIFYING SSPM

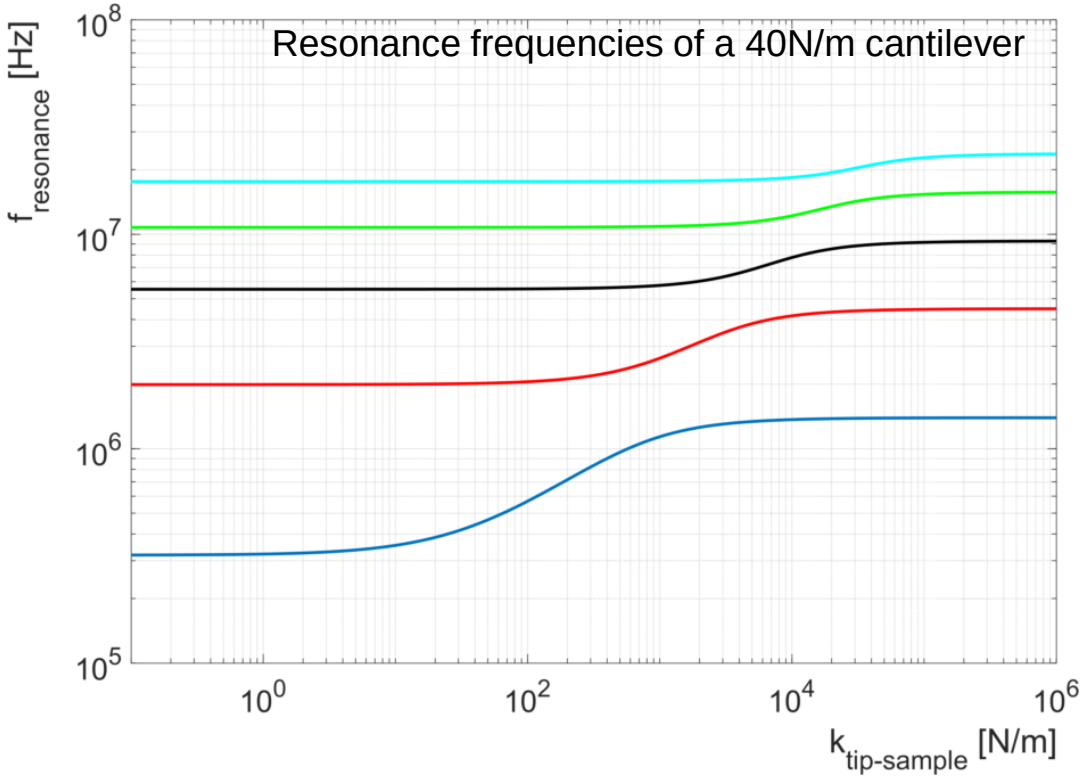




- How to obtain Critical Dimensions from SSPM data?
  - Combine Finite Element Modeling with quantifiable measurements

Euler Bernoulli beam equation:

$$\frac{\partial^2}{\partial x^2}\left(EI\frac{\partial^2 w}{\partial x^2}\right) = -\mu\frac{\partial^2 w}{\partial t^2} + q(x)$$



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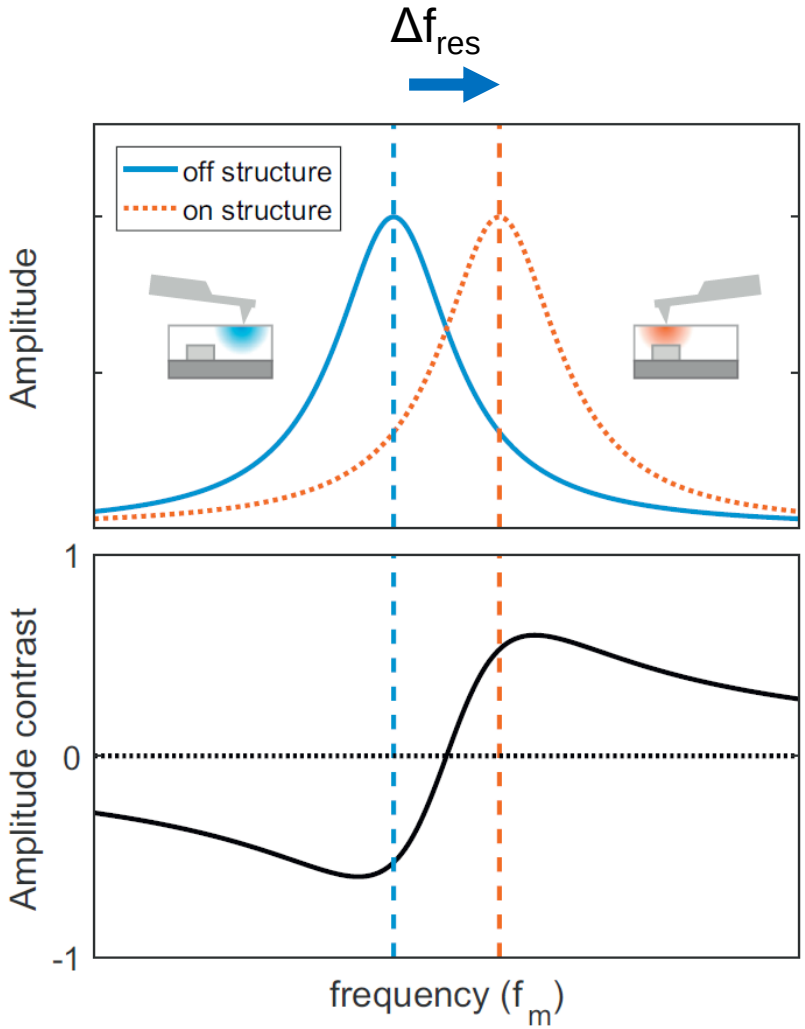

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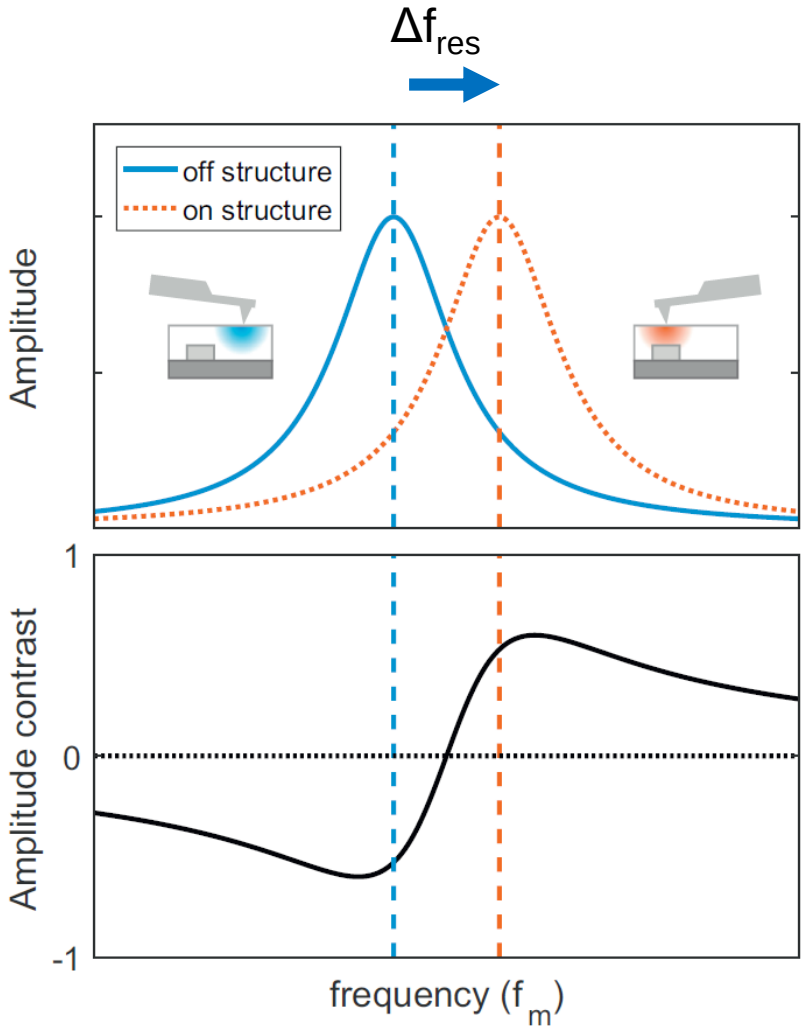

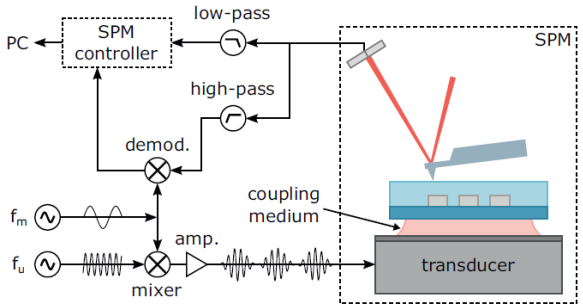

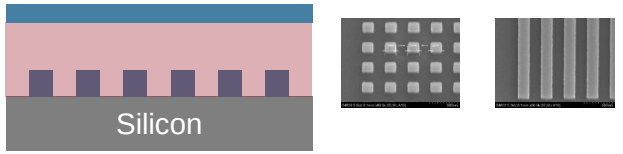

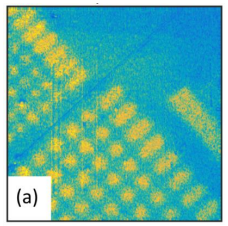

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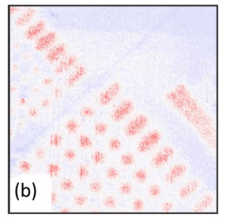
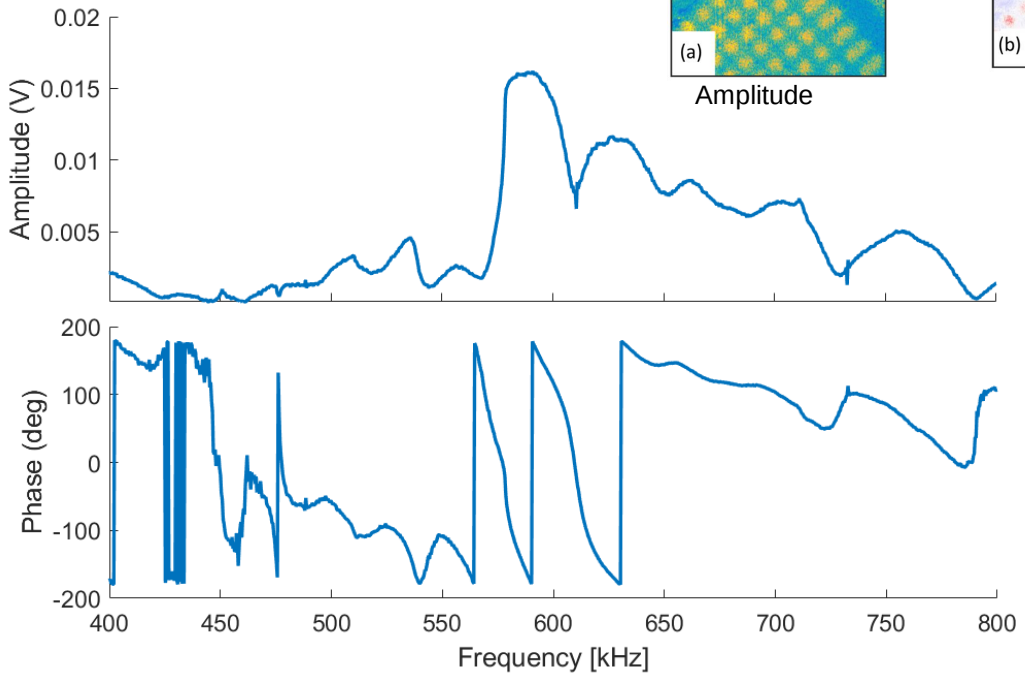
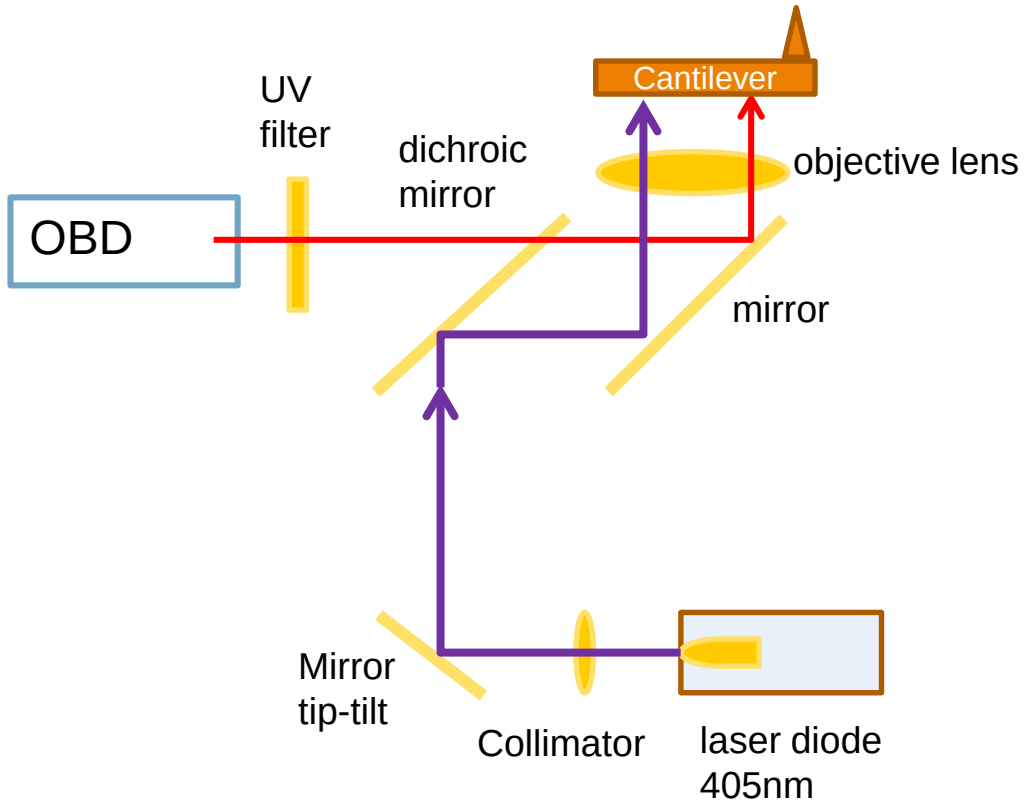
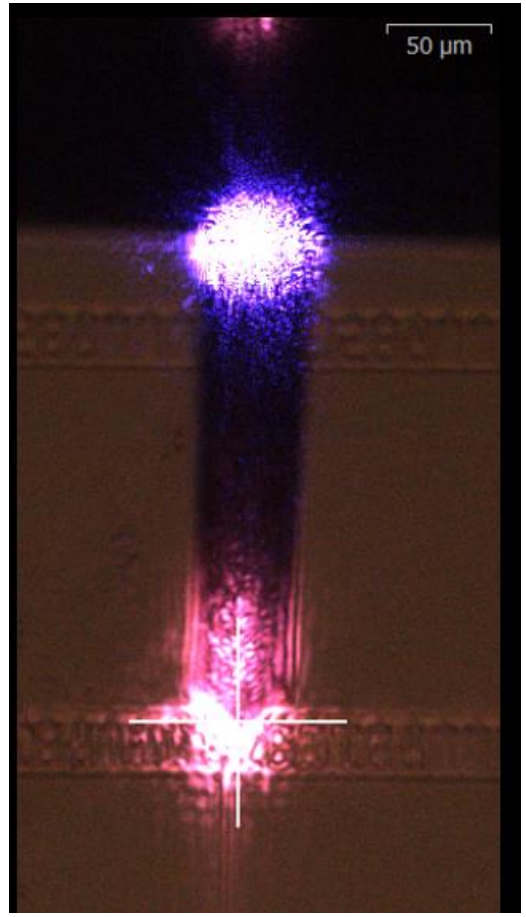


Phase



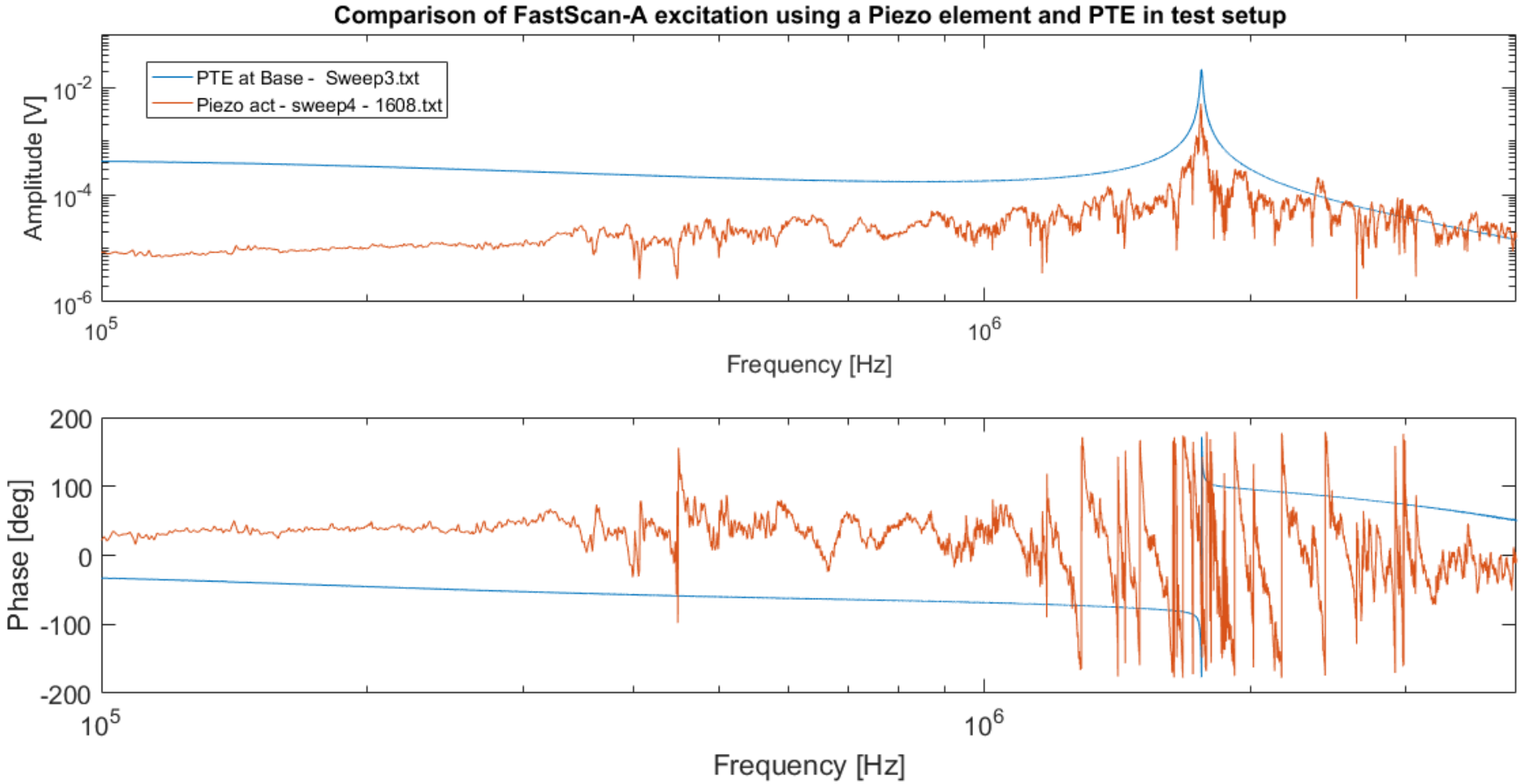
PHOTOTHERMAL ACTUATION





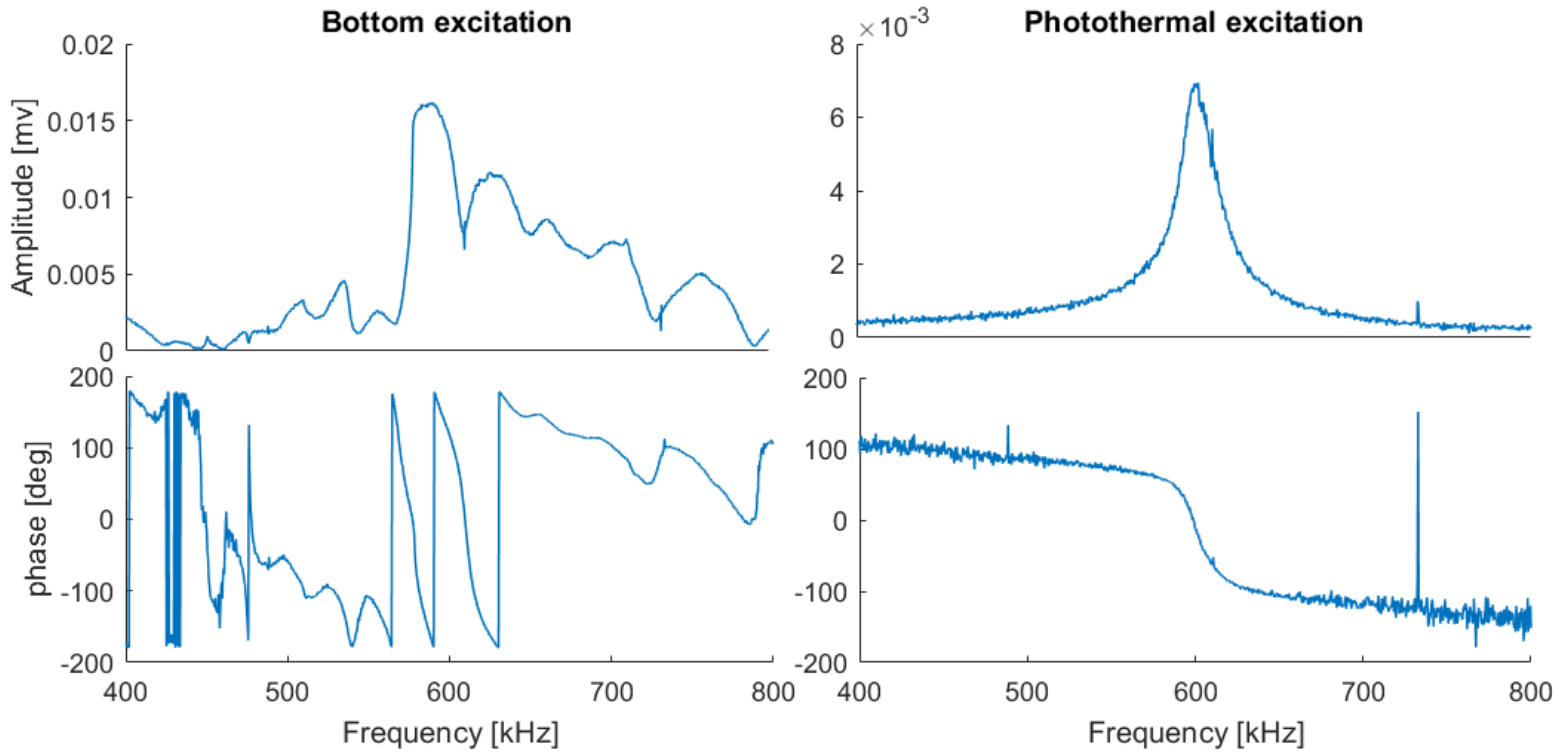
PHOTOTHERMAL ACTUATION

- Excitation spectrum
- piezo vs PTA



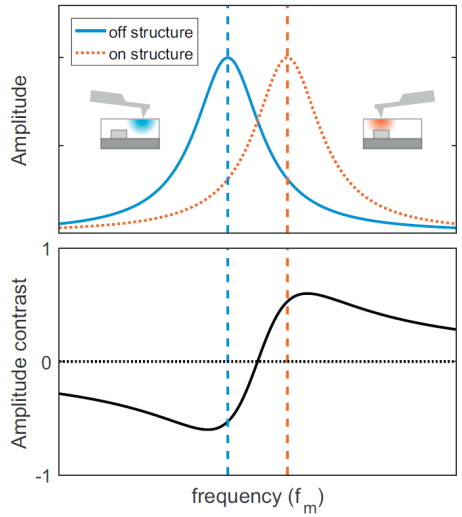
PHOTOTHERMAL ACTUATION

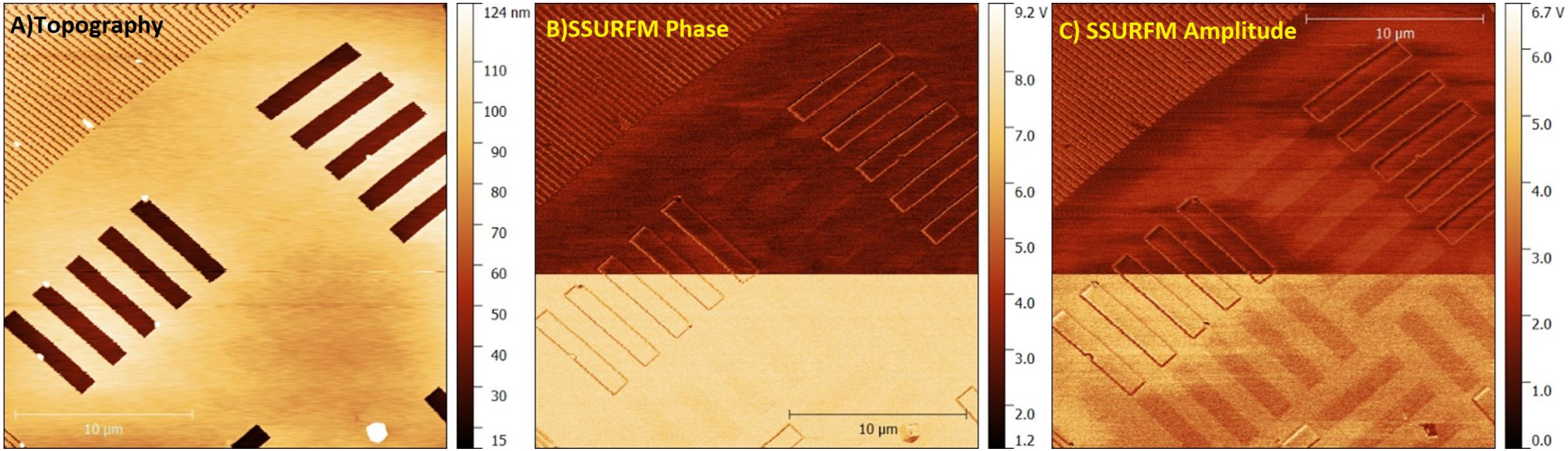
- With tip-sample contact



PHOTOTHERMAL ACTUATION

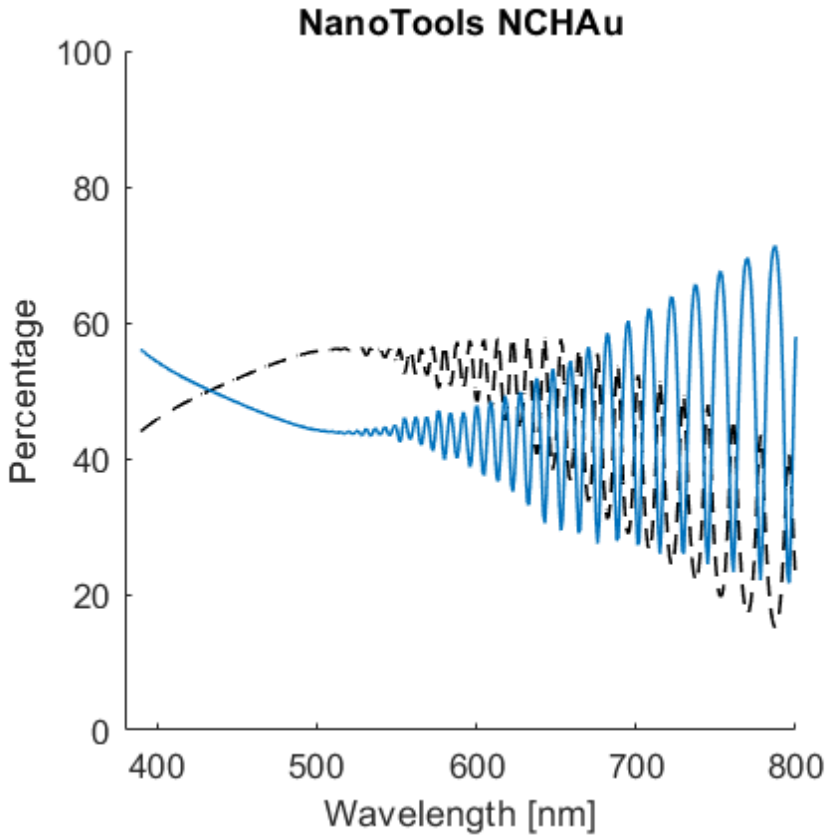
- Initial imaging results

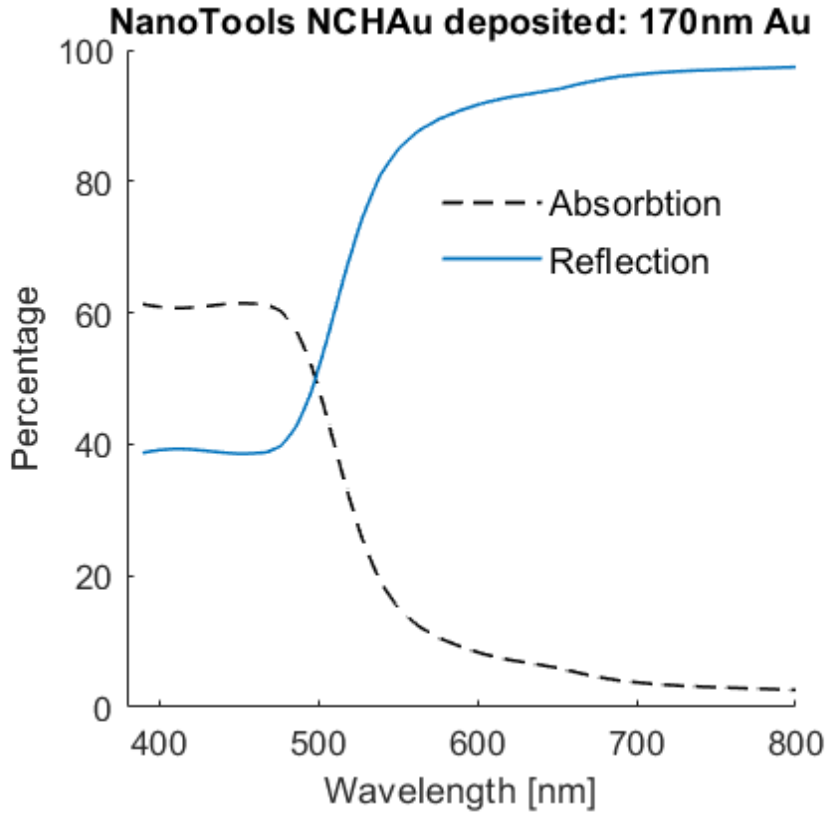




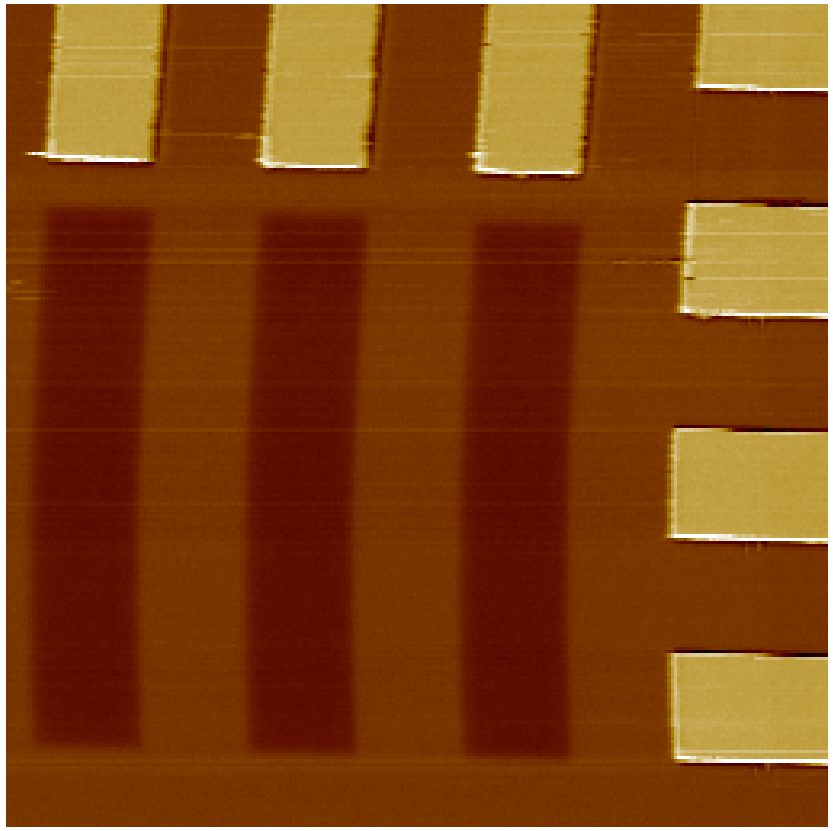
IMPROVED CANTILEVERS: THICKER GOLD COATING

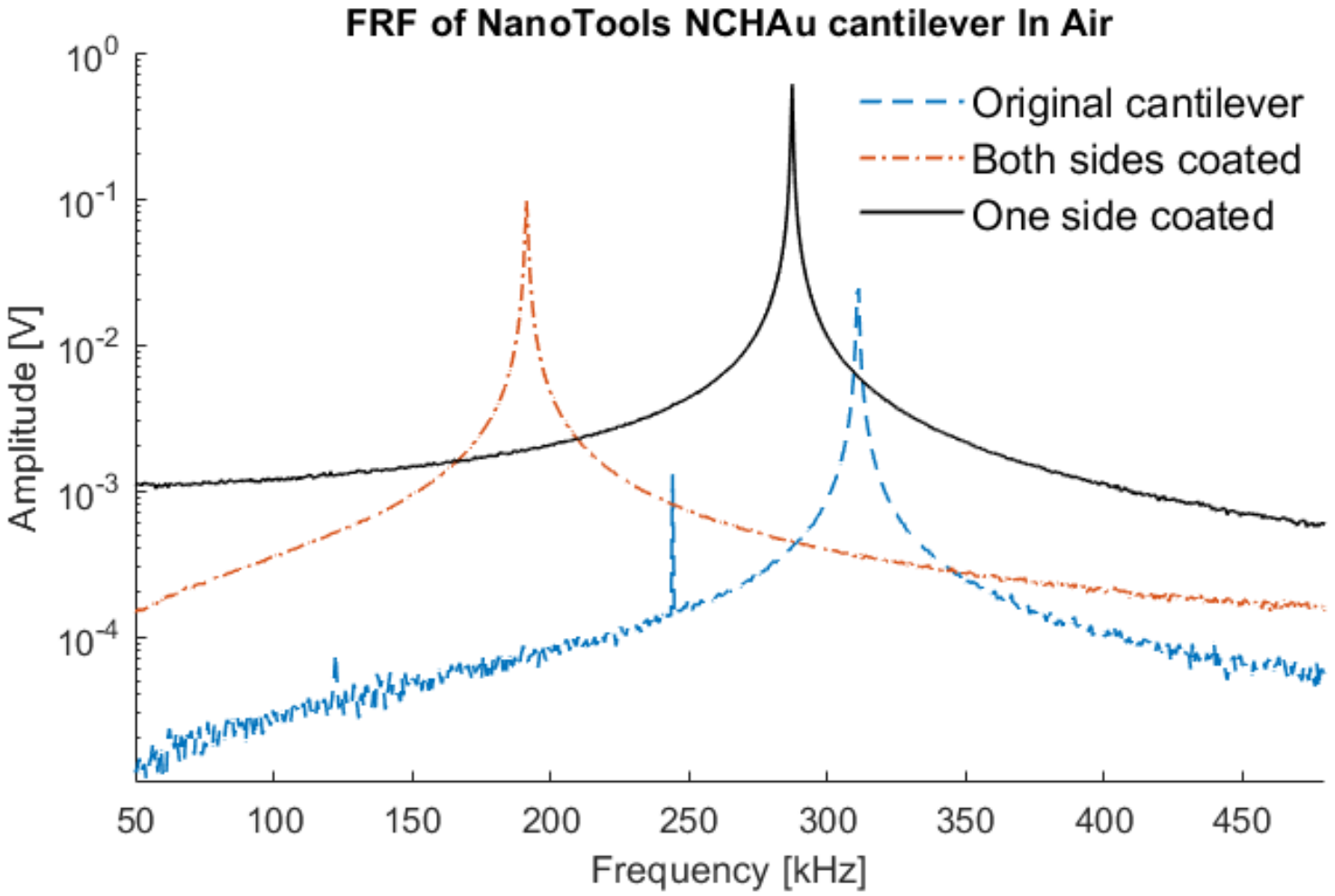
1- mechanical: increased bilayer effect
2- opto-thermal: increased absorption





IMPROVED CANTILEVERS





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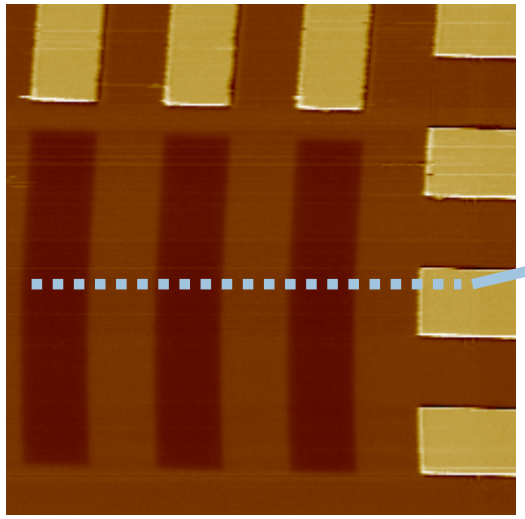
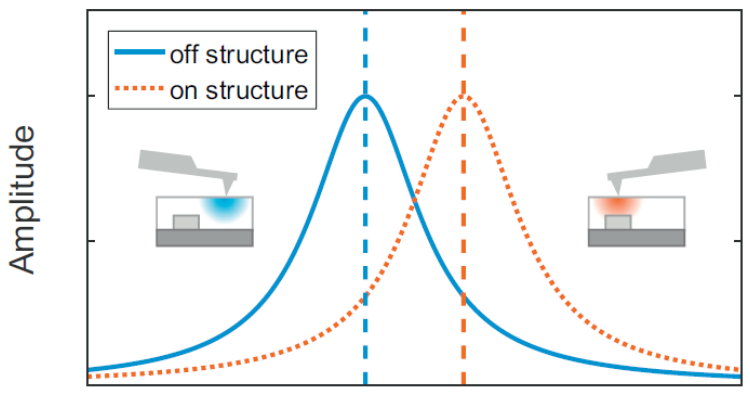
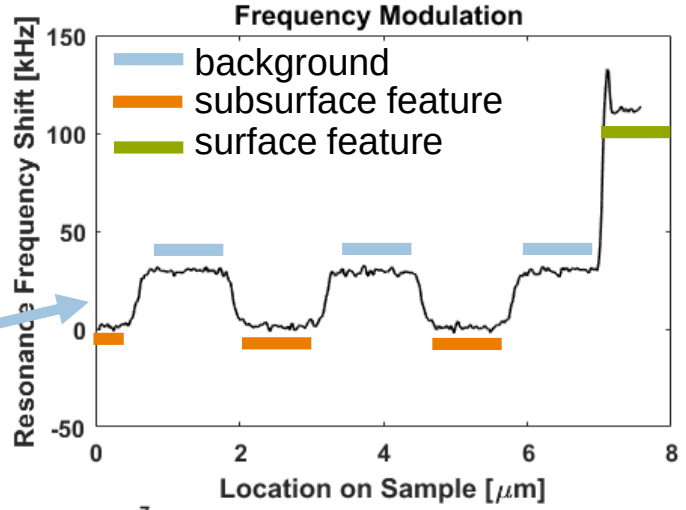
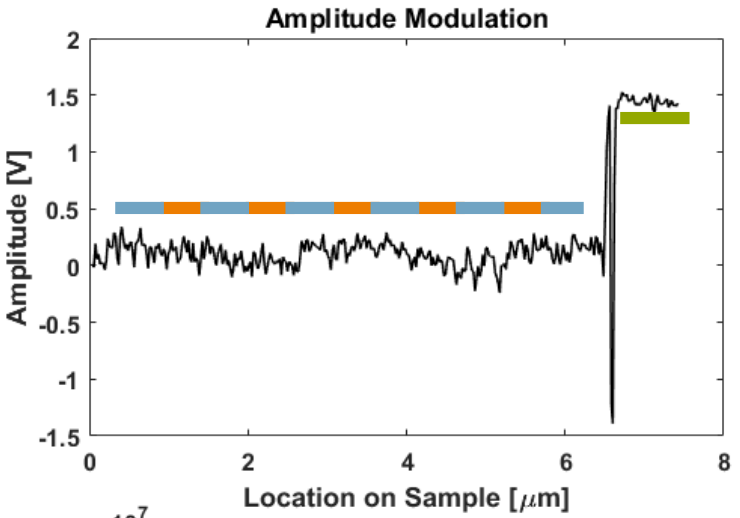
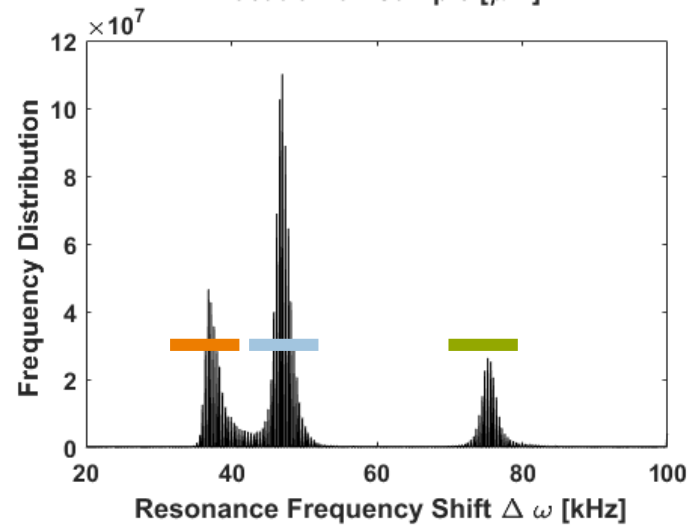
FREQUENCY TRACKING

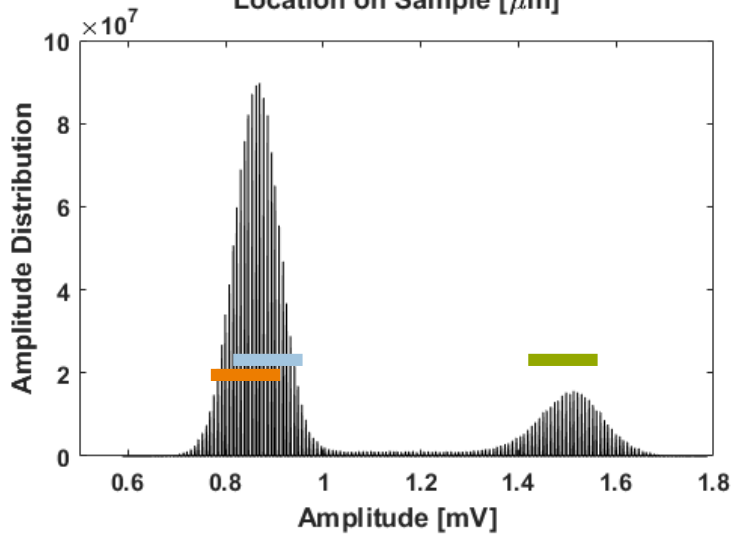












CONCLUSIONS

- Photothermal Actuation
  - provides clean excitation spectrum
  - enables frequency tracking
  - ensures optimal SNR
  - enables quantitative analysis of subsurface signals

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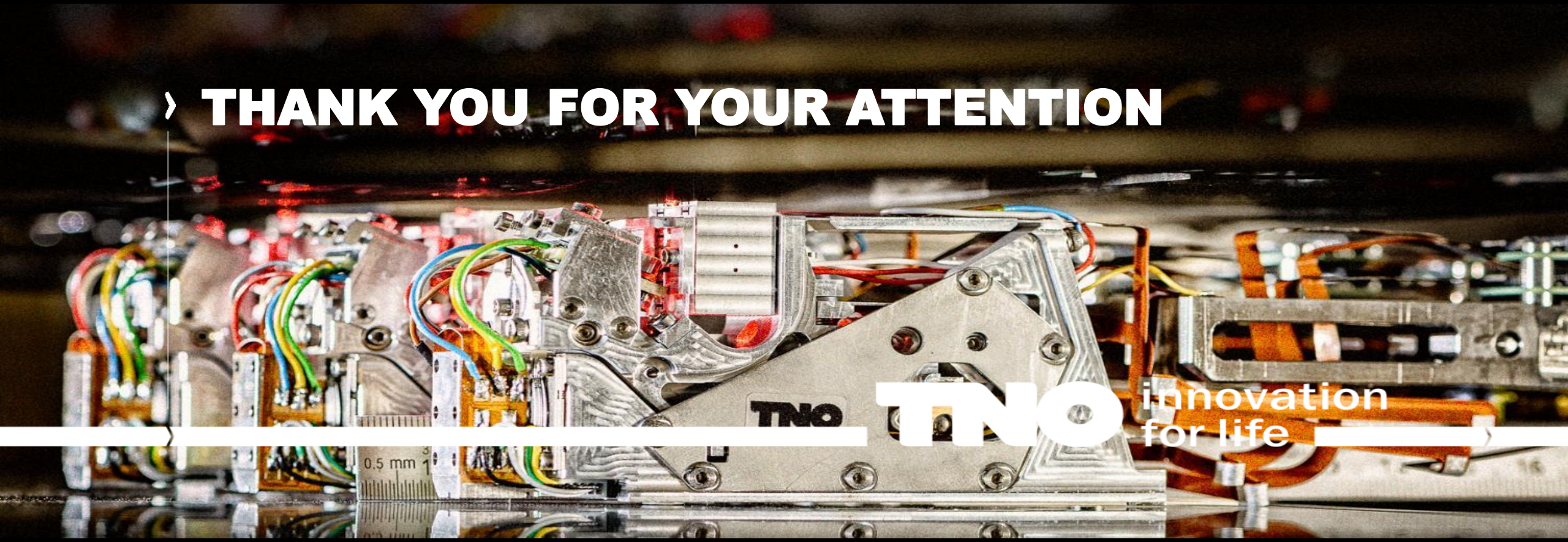
THANK YOU FOR YOUR ATTENTION



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