

# COINS-Related Research at HP

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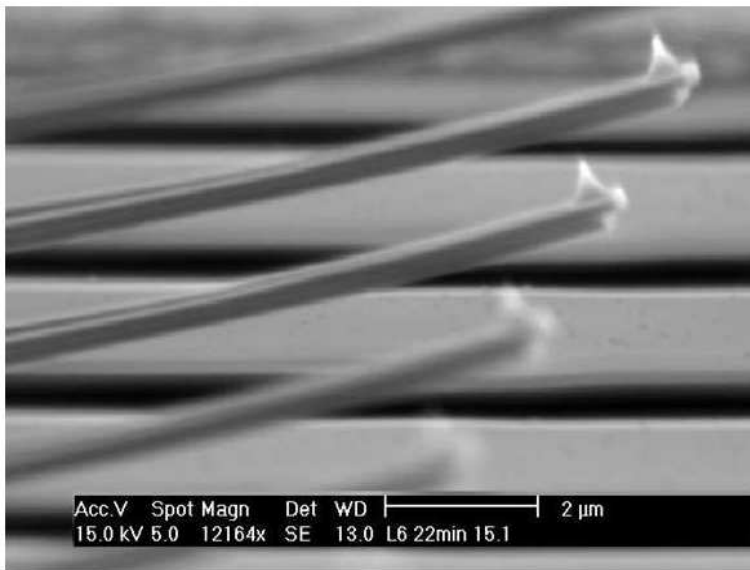
- HP's interest in MEMS and biosensing
- Collaborations, focusing on COINS
- Future work



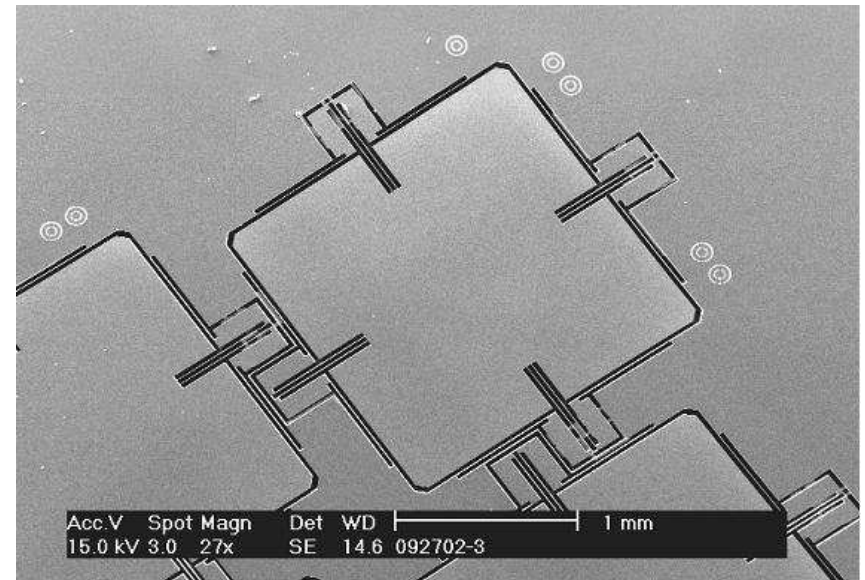
# HP and Nanomechanics

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MEMS were designed and developed with DARPA funding to support data storage projects.



HPL heated-tip cantilever

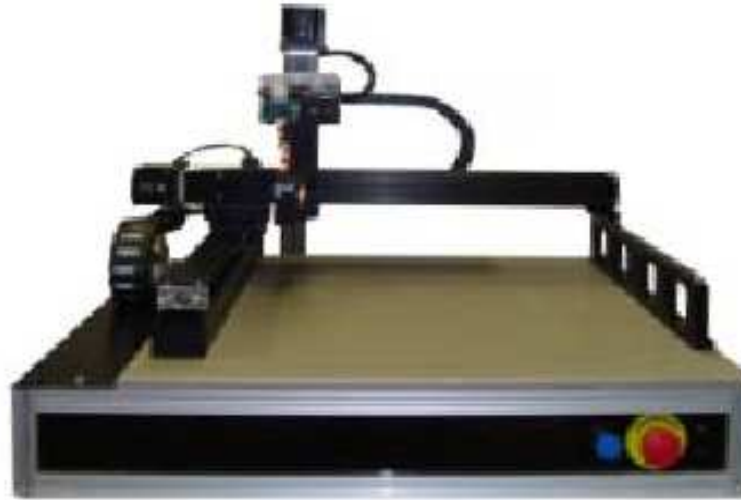


Bulk Si micro X-Y stages

Work of Peter Hartwell, Bob Walmsley and Uija Yoon at HP.

# Agilent HP and Biosensing

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X-y inkjet scanner for functionalizing MEMS devices

## Goals:

- Leverage microfluidics expertise developed for inkjet technology.
- Build ties between microfluidics and computing businesses.
- Use hardware strengths to develop a broader “Wellness” strategy.

# Outside collaborations: benefits and barriers

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- As HP Labs becomes smaller, university collaborations become imperative.
- **Ongoing work with:**
  - University of Puerto Rico (government funding);
  - UC Davis (pending NSF proposal);
  - MIT (HP-funded);
  - Berkeley (HP-funded).
- **Main problem:** intellectual property agreements.
  - Preference for joining Centers;
  - HP belongs to COINS and CITRIS but not BSAC;
  - Hope that blanket agreement can be fashioned.
- **Principle:** HP will not pay to license patents that are developed as part of research we sponsor.

## Education and outreach

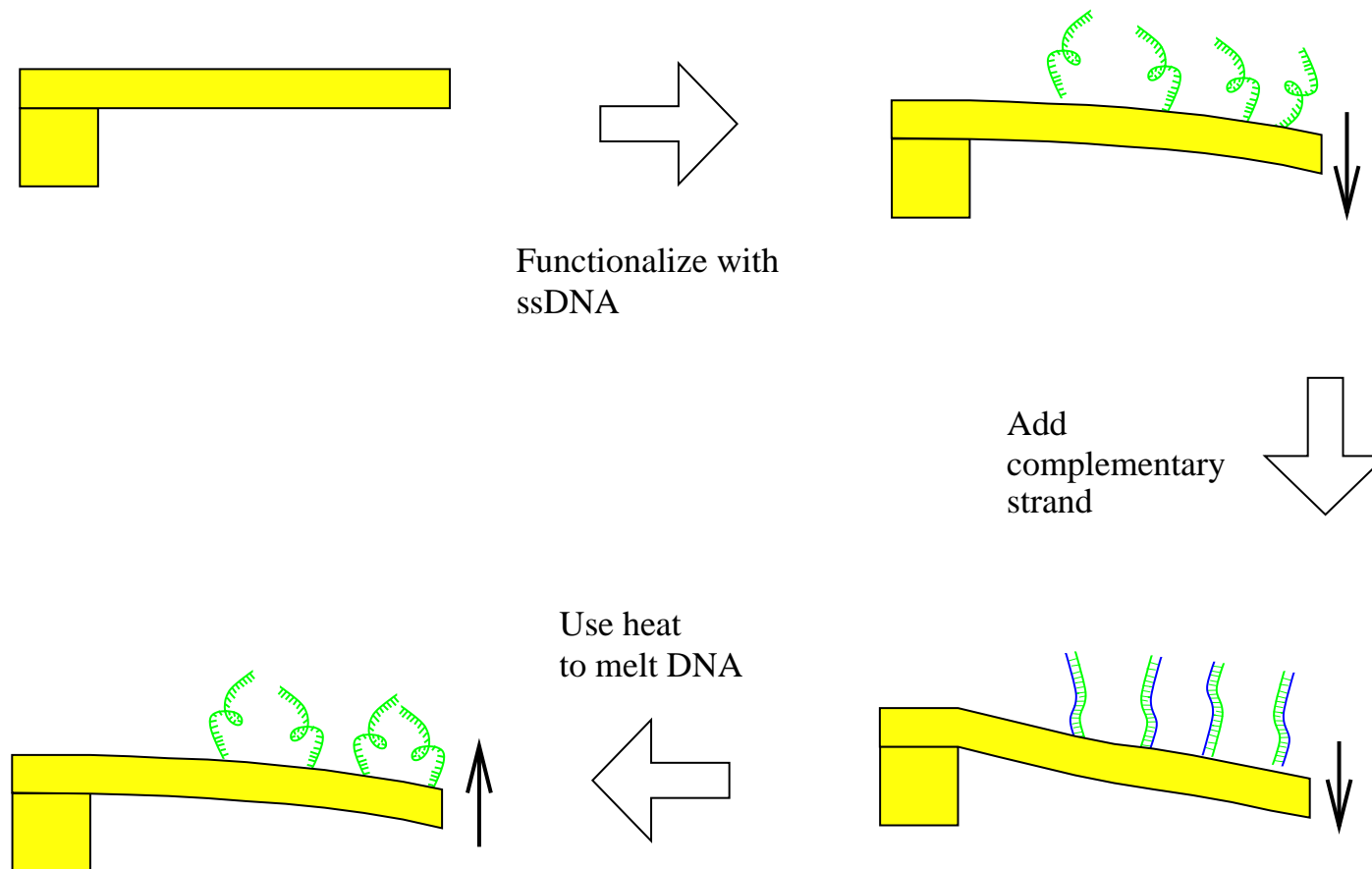
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HP strongly supports NSF and its educational mission:

- Dave Packard founded Silicon Valley Leadership Group in large part to support local education.
- This summer two HP-funded students will work on biosensing at UPR.
- Through CITRIS/COINS we are funding postdoc Lisa Biswal.
- HP supports service on NSF committees.
- What we desire from universities is trained engineers and new ideas, not product prototypes.

# Collaboration with Prof. Majumdar via COINS

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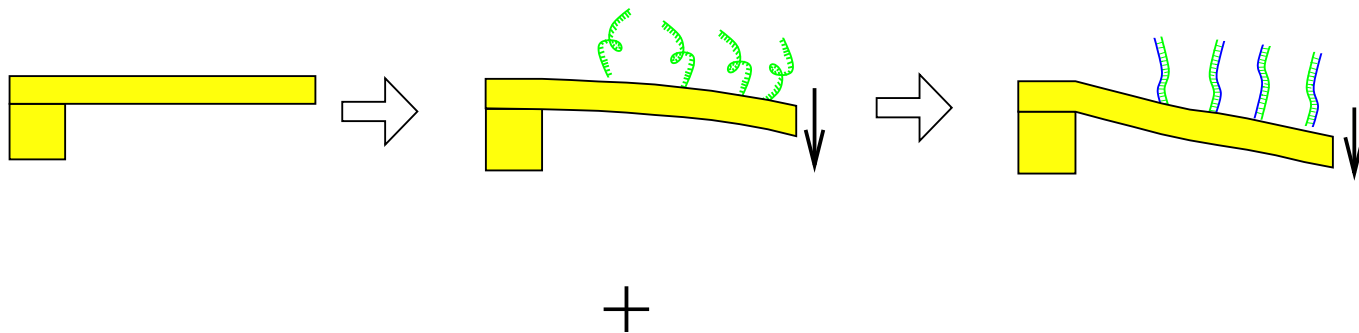


Temperature at which DNA denatures depends on length, degree of basepair matching, fraction which is GC — a useful added diagnostic to existing assay.

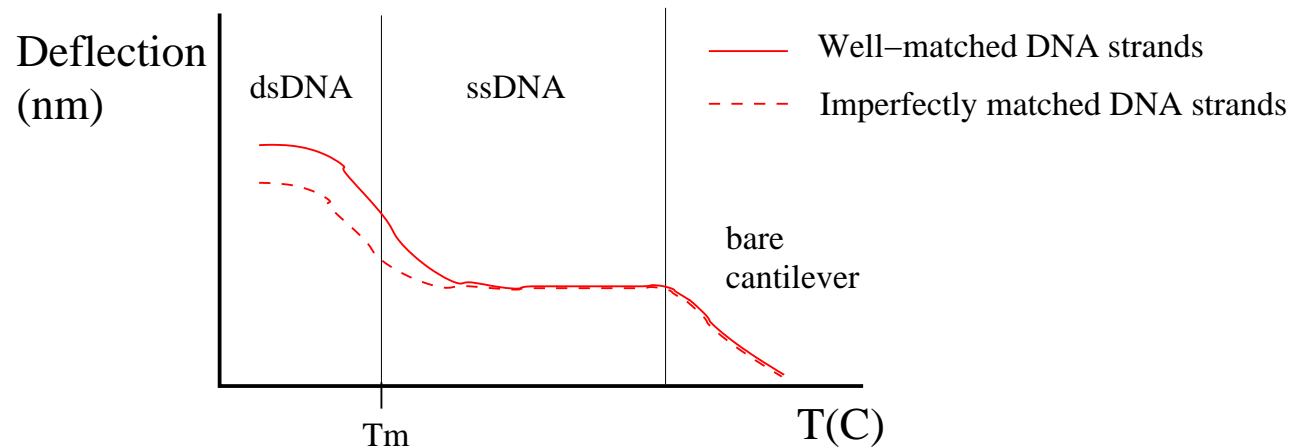
# COINS project

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## Existing Cantilever Deflection Assay

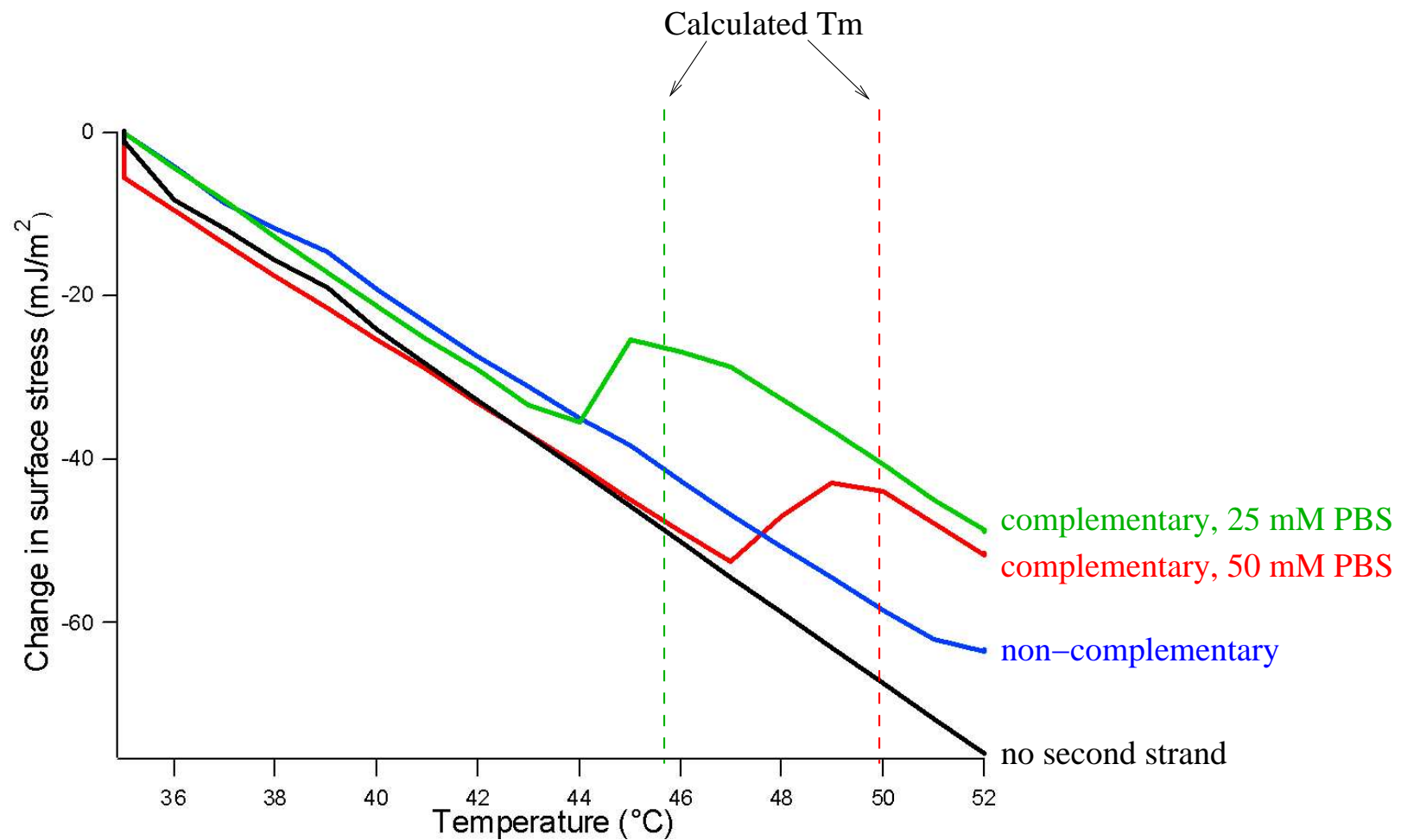


## Additional New Thermal Measurements (sketch)



Identifies degree of matching via  $T_m$ , similar to LightTyper.

# First Data on DNA Melting with Cantilevers

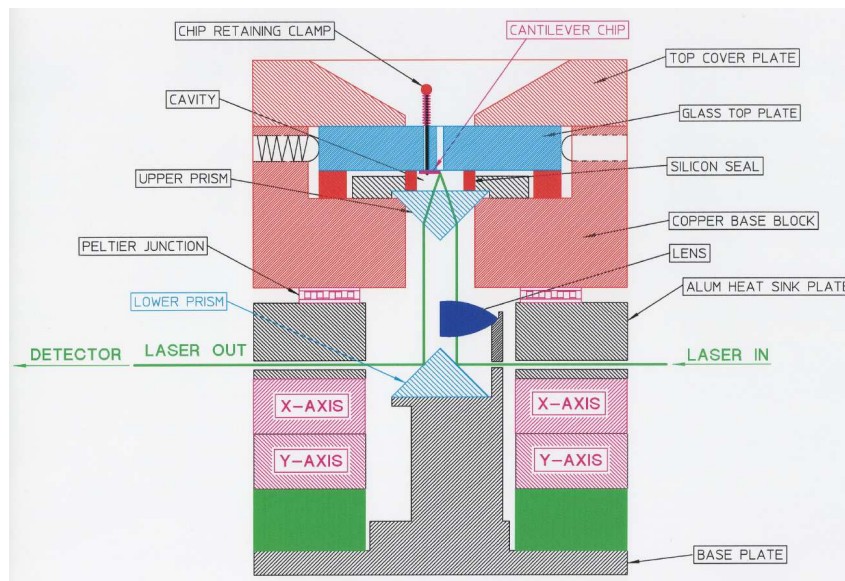


Work of postdoc Lisa Biswal.



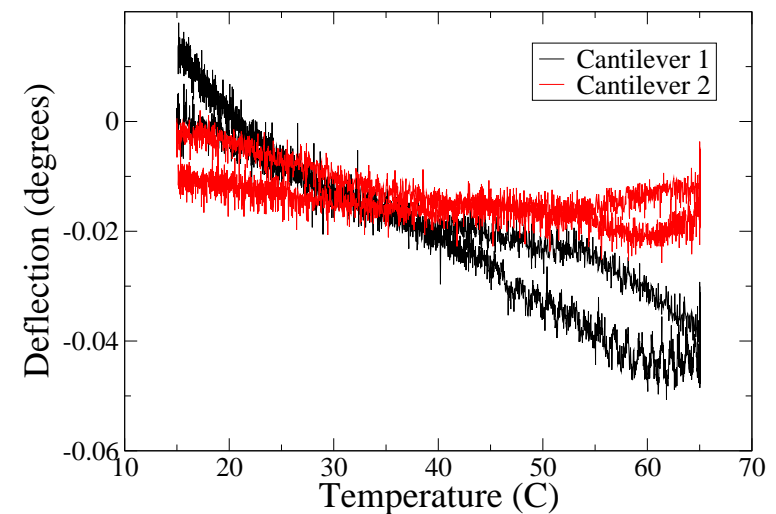
# New Temperature-Scanning Apparatus at HP

Designed to optimize thermal uniformity and control.



Apparatus diagram

Two Au-coated cantilevers on the same chip



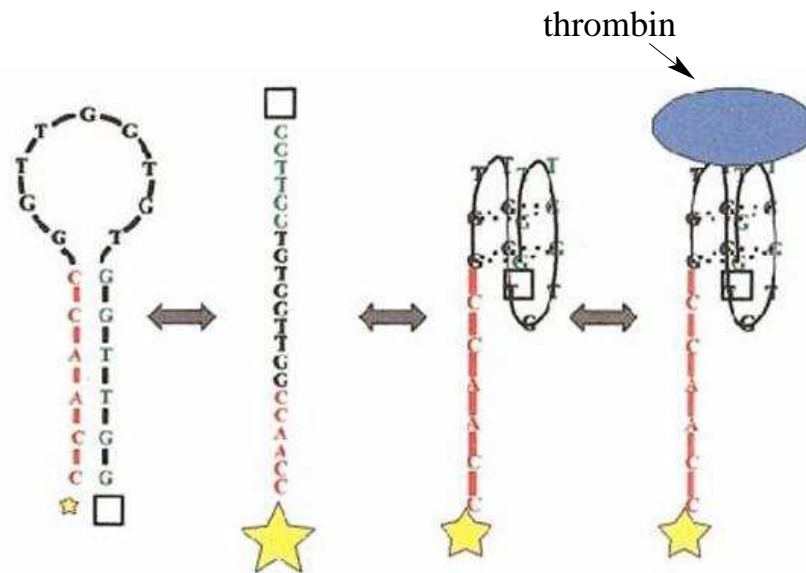
Test with water

Work of Henryk Birecki and Graeme Burward at HP.

## Extension to DNA-Protein Binding

**Idea:** leverage existing UCB knowledge about DNA immobilization on cantilevers to study DNA-protein binding.

**Importance:** relevance to gene regulation via transcription factors.

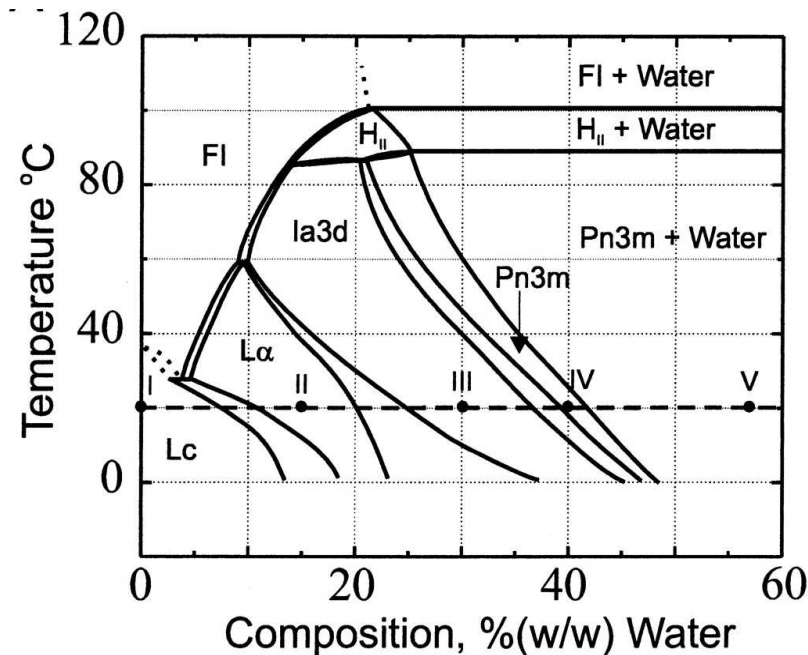


Aptamer-DNA binding studied by NSF-supported Ellington group at U. Texas.

# Vision for the Future

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**Ultimate goal:** statistical mechanics insight into biomolecular thin films (including membranes) via  $\Pi$ -T-x phase diagrams.



NSF-supported work of Caffrey group, Ohio State University.

**Concept:** study cell constituents using nanomechanical sensors with dimensions similar to cells.

## Future Work with COINS and Summary

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- HP has many Wellness programs, some on biosensing.
- HP desires to leverage its existing inkjet, MEMS and computing expertise.
- Barriers to collaboration are mainly related to IP.
- IP concerns lead to preference for Center model.
- Proximity, overlap of interests and ease of interaction compel collaboration with COINS.