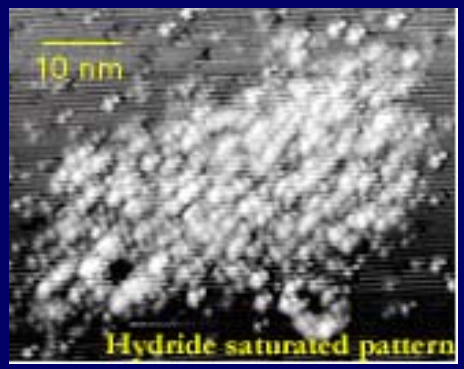
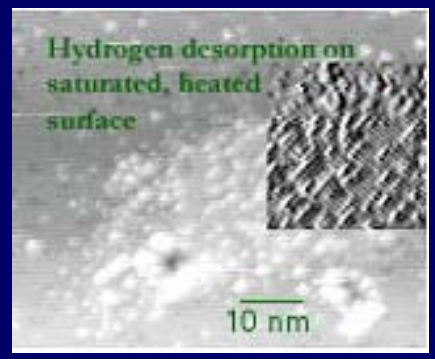
# Selective Silicon Epitaxy Seen at the Nanometer Scale




**Matthew M. Sztelle**

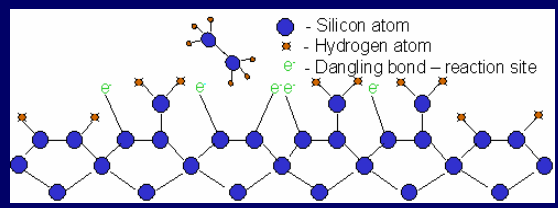
sztelle@uiuc.edu




Research Assistant for Professor Joe Lyding

Scanning Tunneling Microscopy Group: Beckman Institute
University of Illinois Urbana-Champaign

ECE Illinois
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING




**Nanohour**
**April 25, 2007**

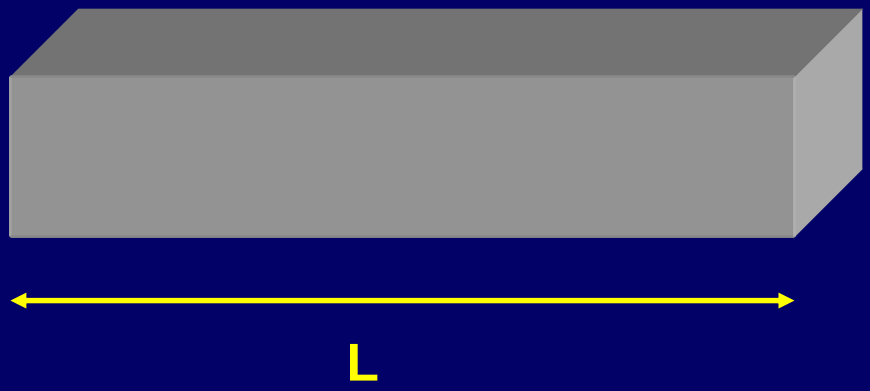
# Outline

- Motivation for NEMS
- Scanning Tunneling Microscopy and its role
- Silicon epitaxy temperature dependency
- Vacancy diffusion
- Nanometer scale epitaxy

# NEMS: Nanoelectromechanical Systems

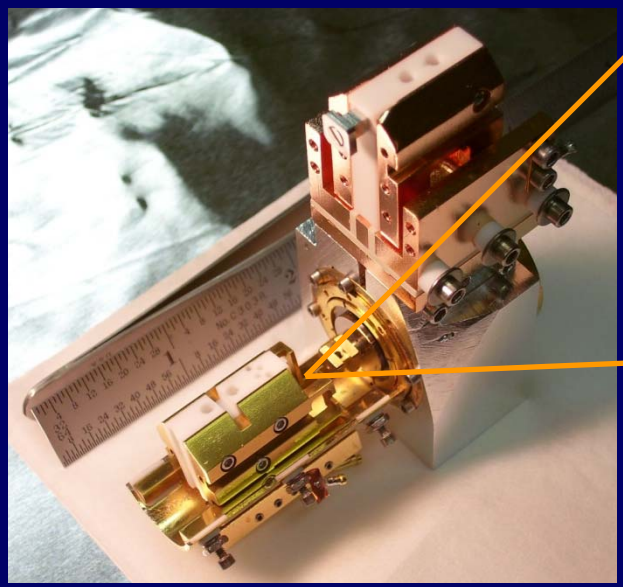
Allow physical phenomena to be coupled with integrated circuits

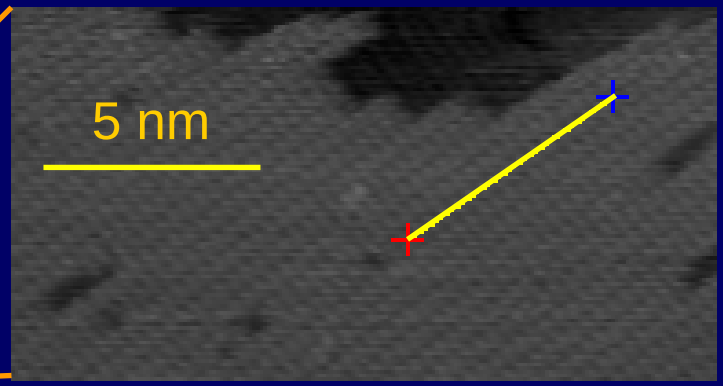
Cantilever:

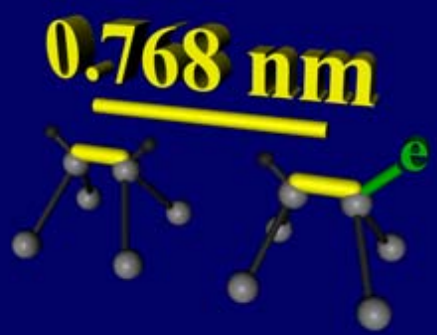



$$f_0 \propto \frac{1}{L^2}$$

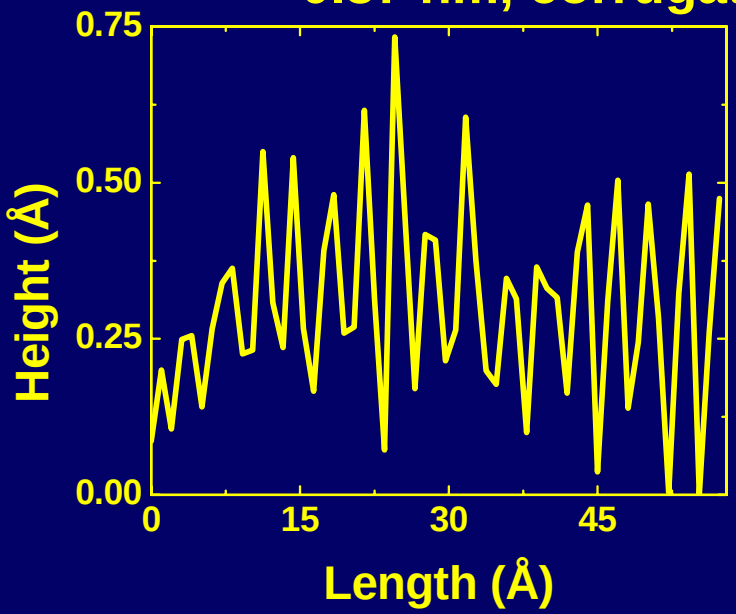
# Scanning Tunneling Microscopy (STM): Ideal for Nanometer-Scale Work






~ 0.37 nm, corrugation

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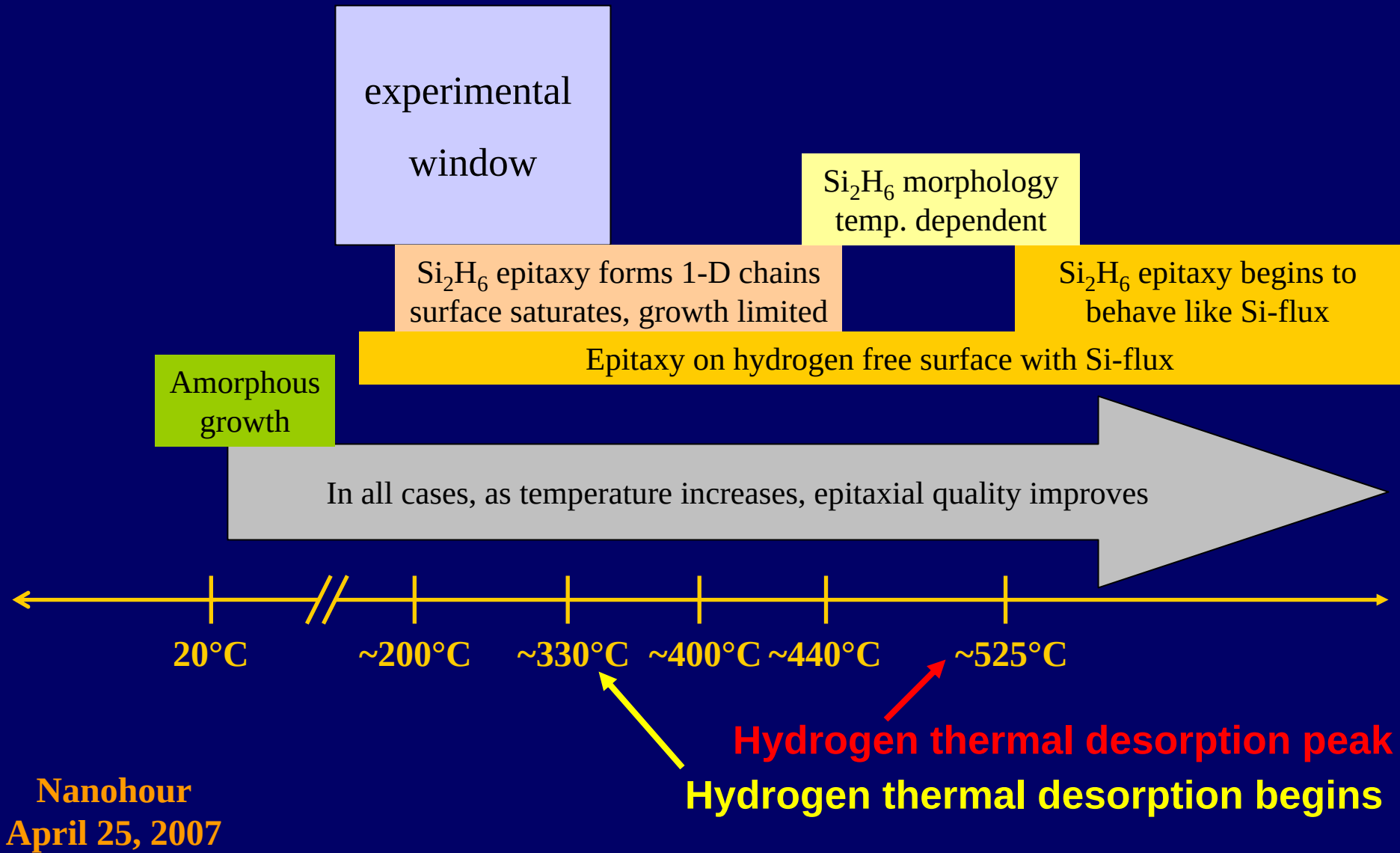
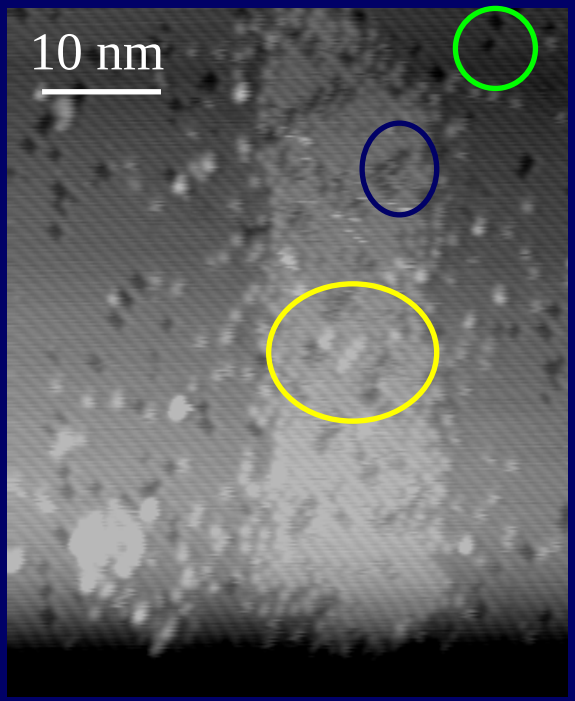
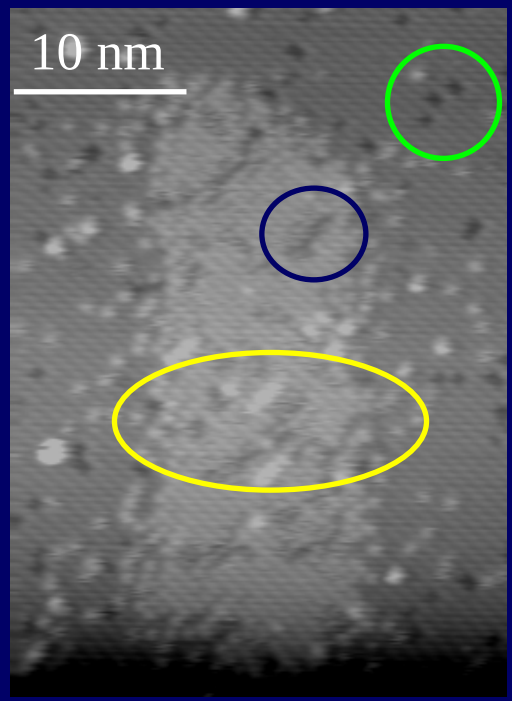
# Epitaxy Temperature Dependency



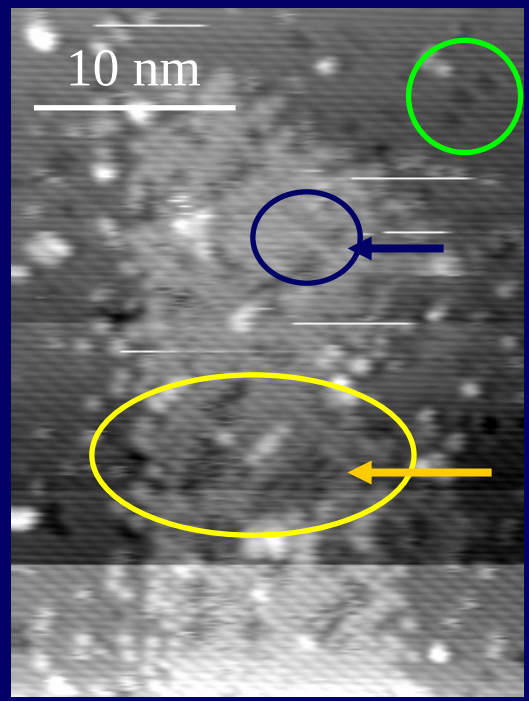
# Surface Phenomena at 220°C: No disilane




t = 0 min.



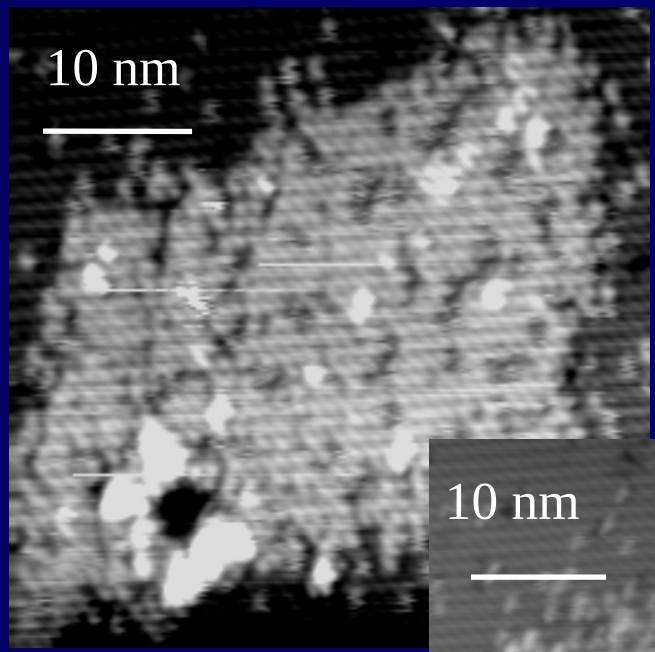

t = 4 min.



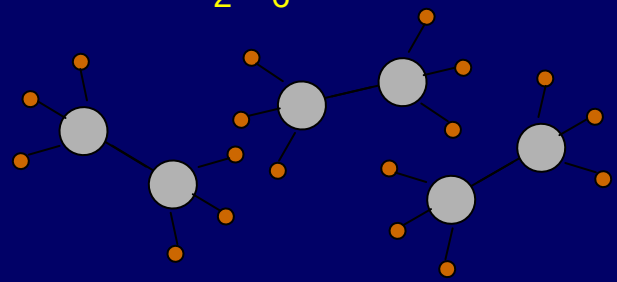

t = 9.5 min.

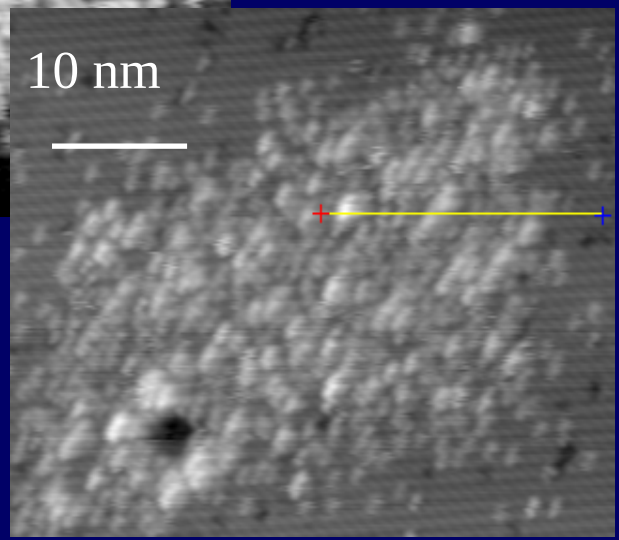
- This behavior is NOT observed at room temperature

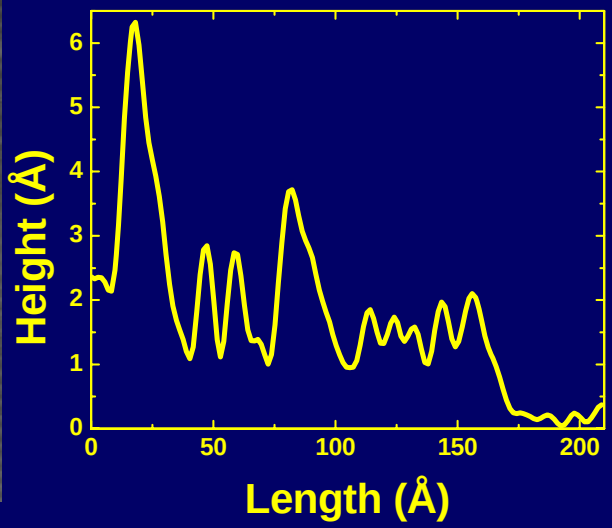
# Silicon Epitaxy – Initial Patterning & Saturation



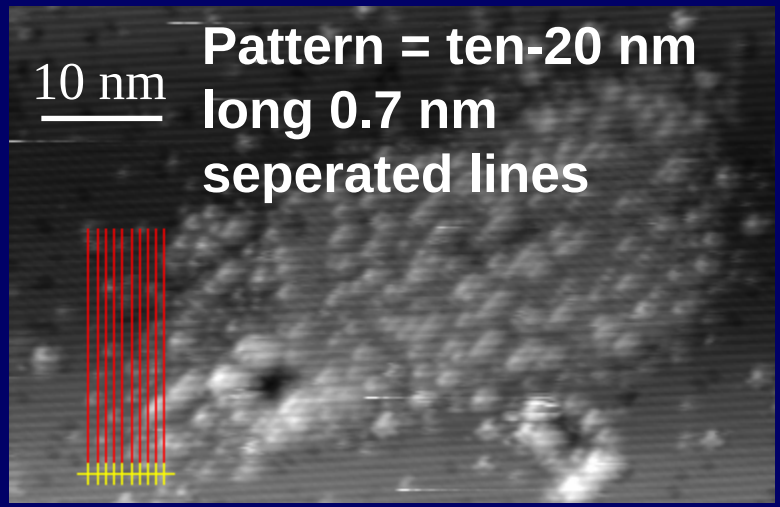

Disilane: $Si_2H_6$ - $5\times10^{-9}$ Torr

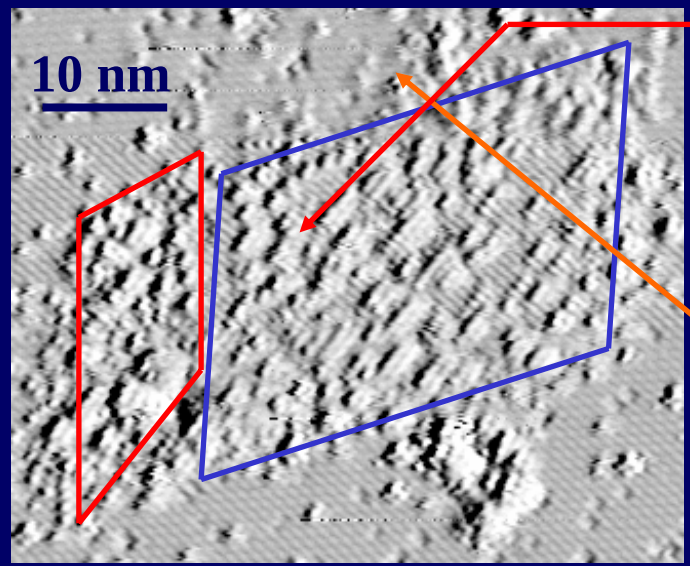


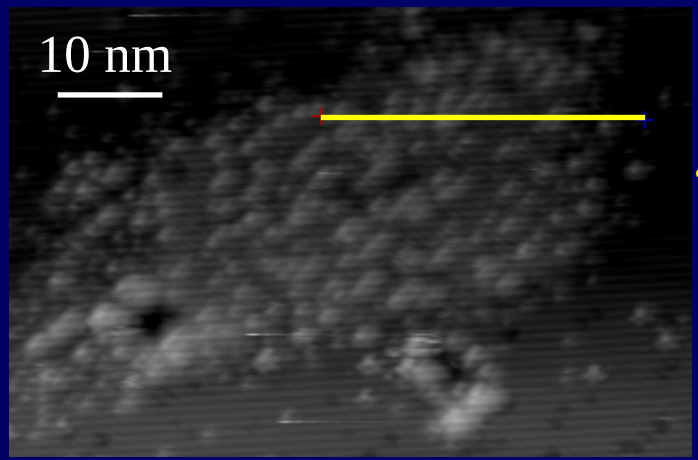


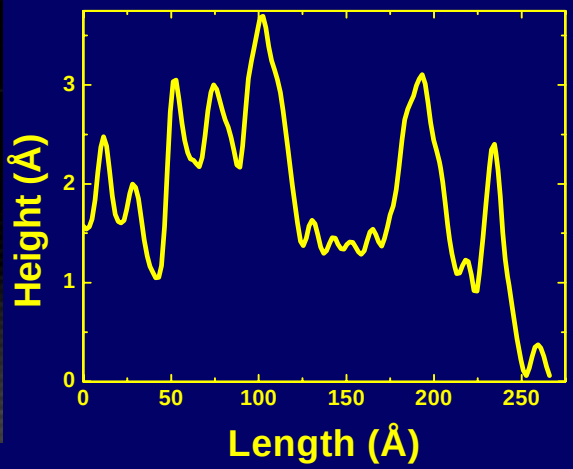



# 1-D Dimer Chain Formation After Hydrogen Removal

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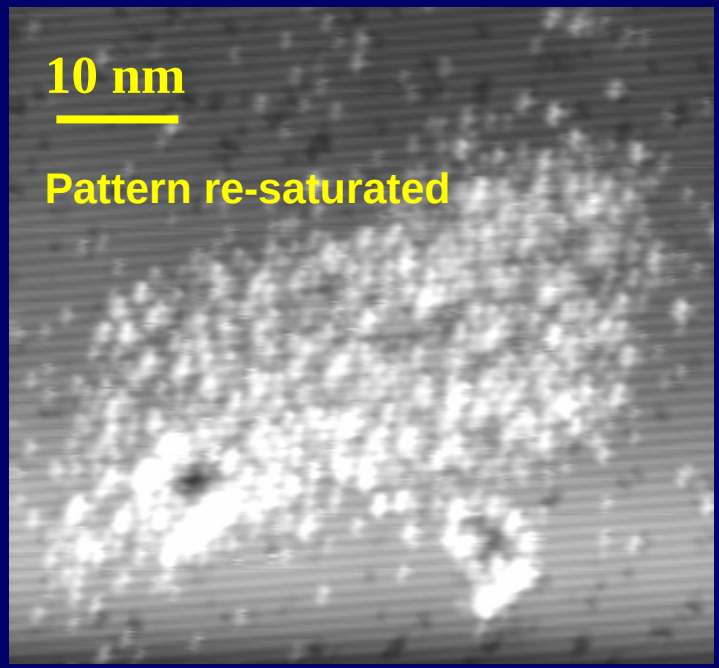
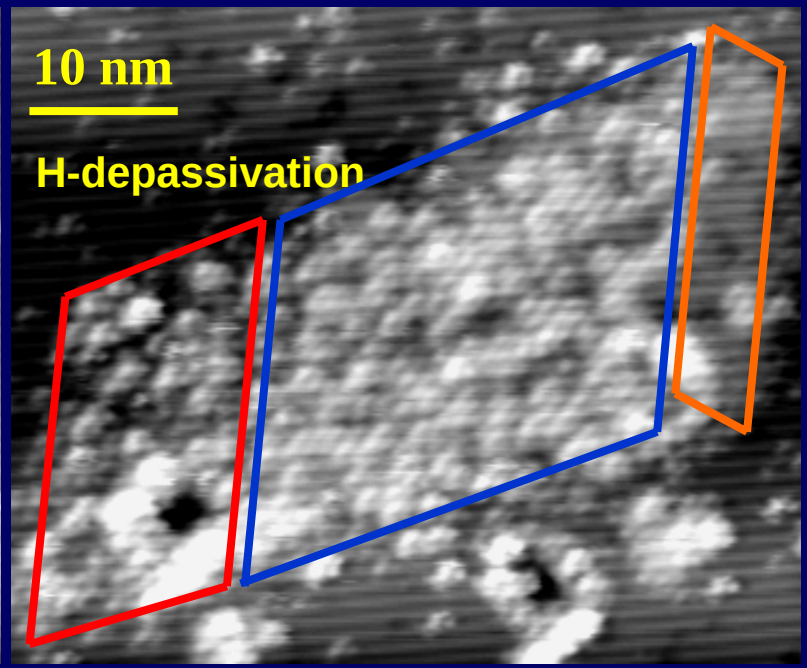
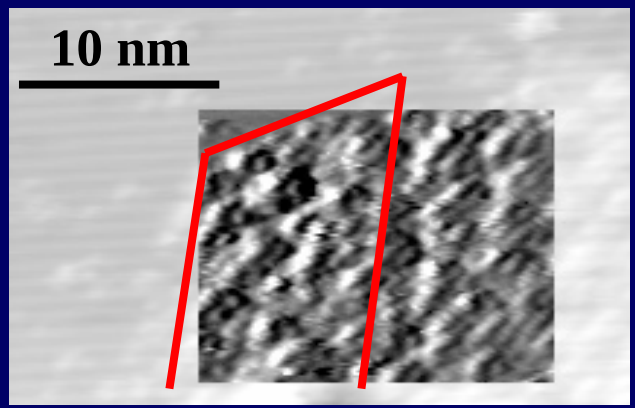
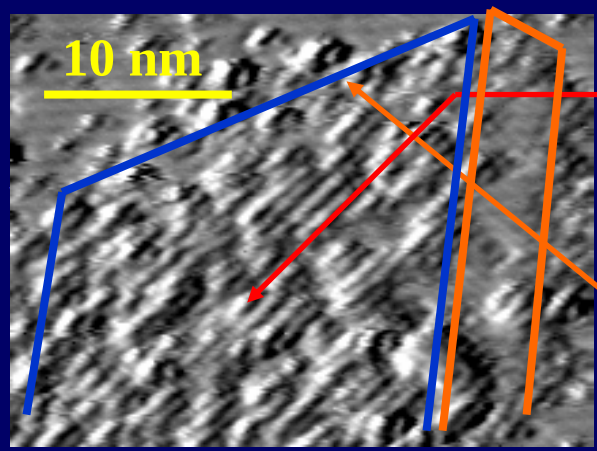
# Increasing Pattern Coverage



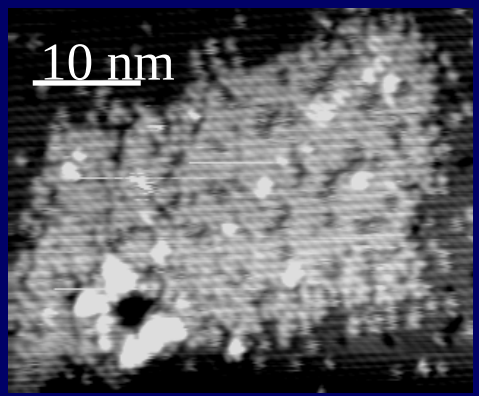



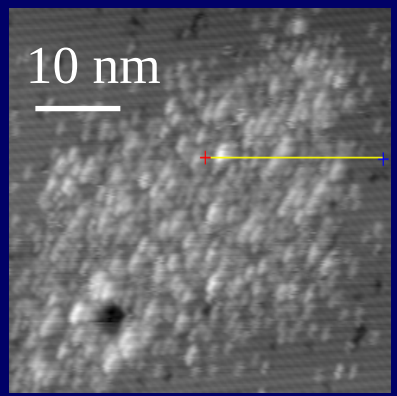



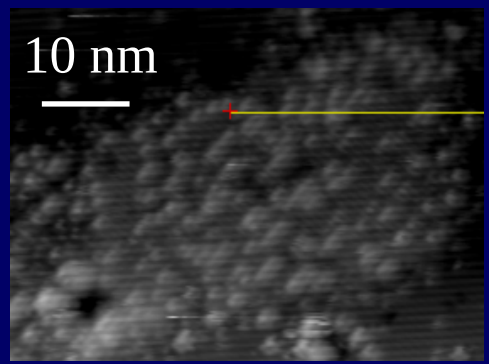



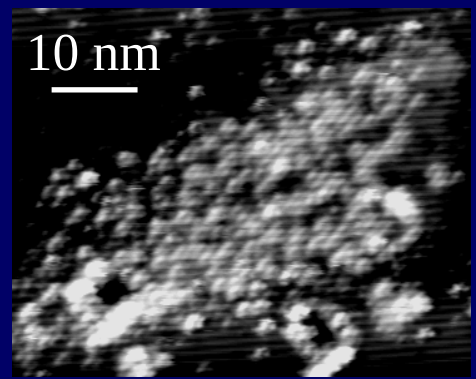
# Conclusion

- Demonstrated nanoscale selective patterning on the hydrogen-passivated Si(100) surface at elevated temperatures
- Deposited silicon-hydride and hydrogen species on pattern
- Removed hydrogen and saw 1-D dimer chain formation
- Repeating process increased surface coverage

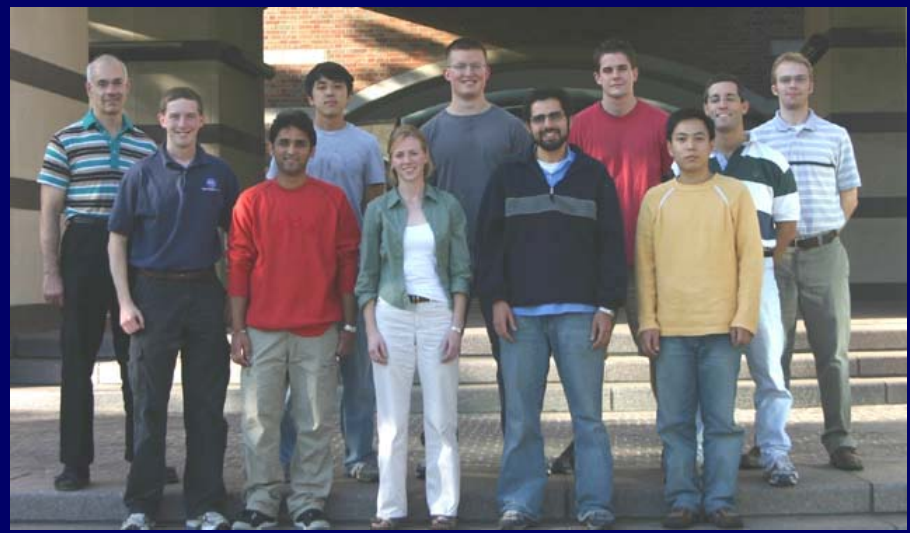


# Acknowledgements




- Professor Joe Lyding
- Laura Ruppalt
- Kyle Ritter
- Scott Schmucker
- Peter Albrecht
- STM Nanofabrication and Characterization Group (University of Illinois)

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