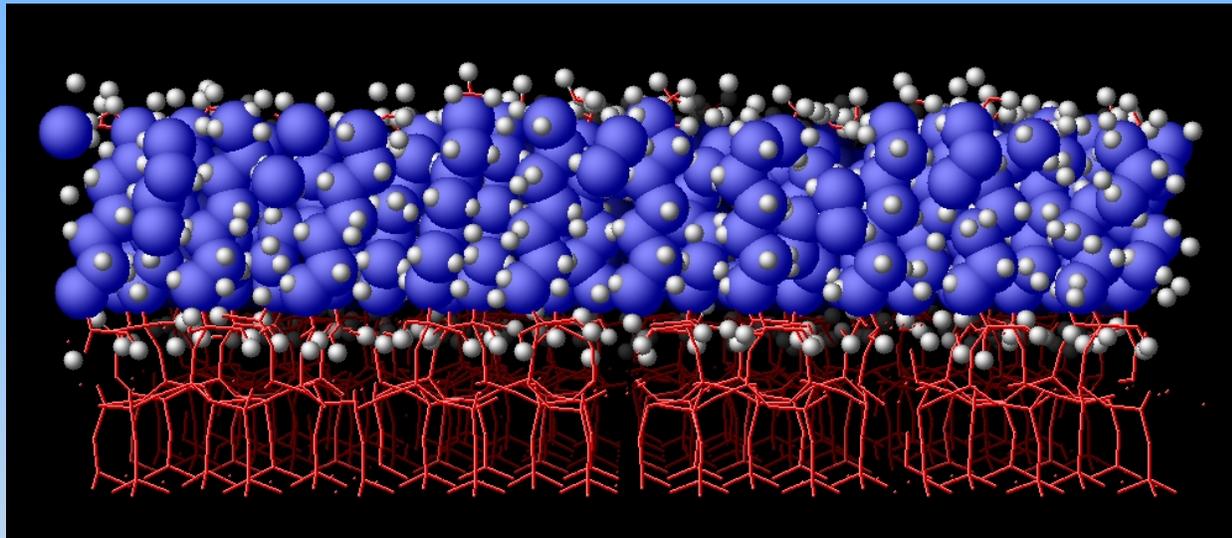


# Simulations of Nanotribology of Self-Assembled Monolayers

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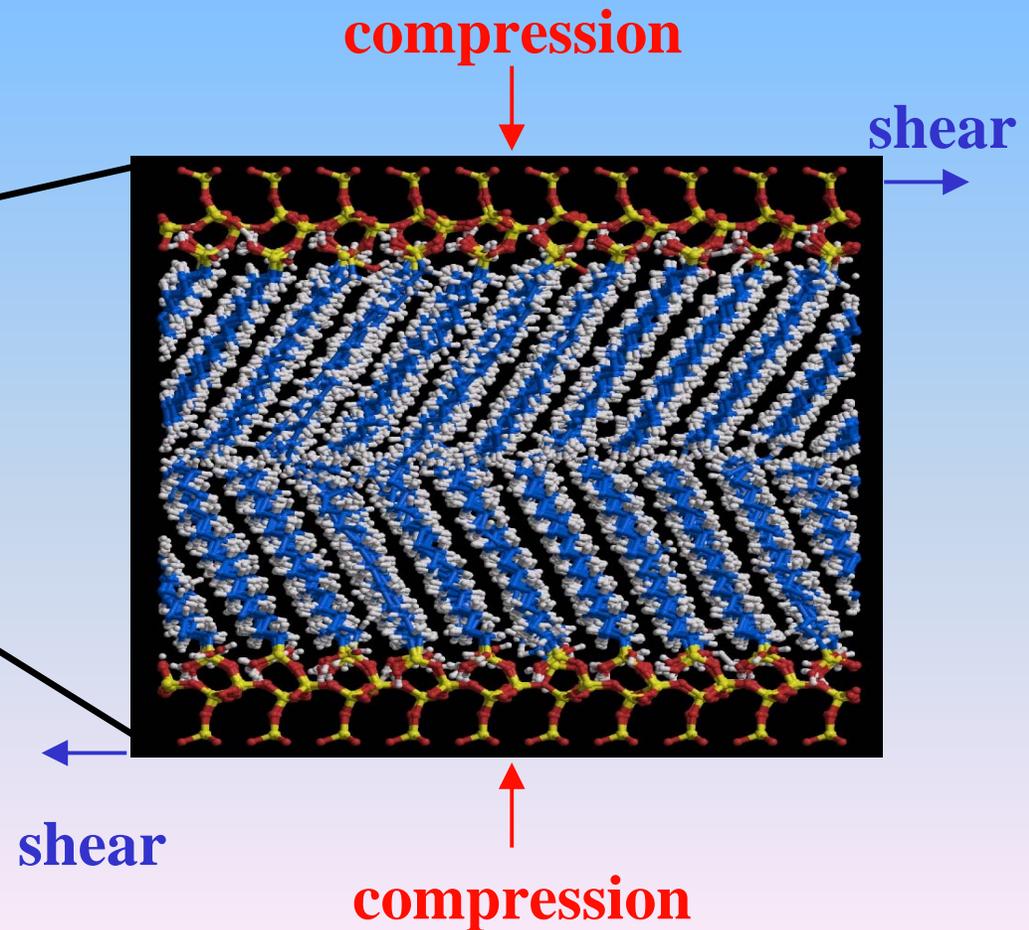
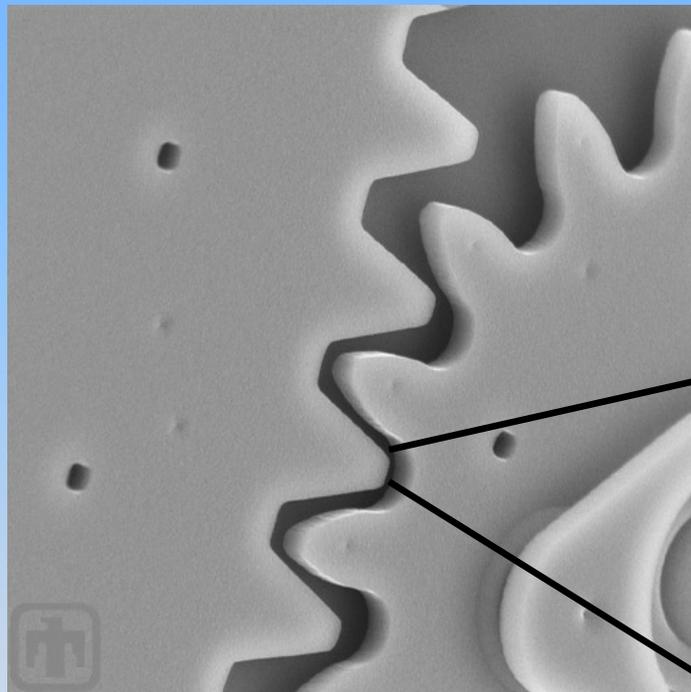


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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

# Friction and Adhesion in MEMS

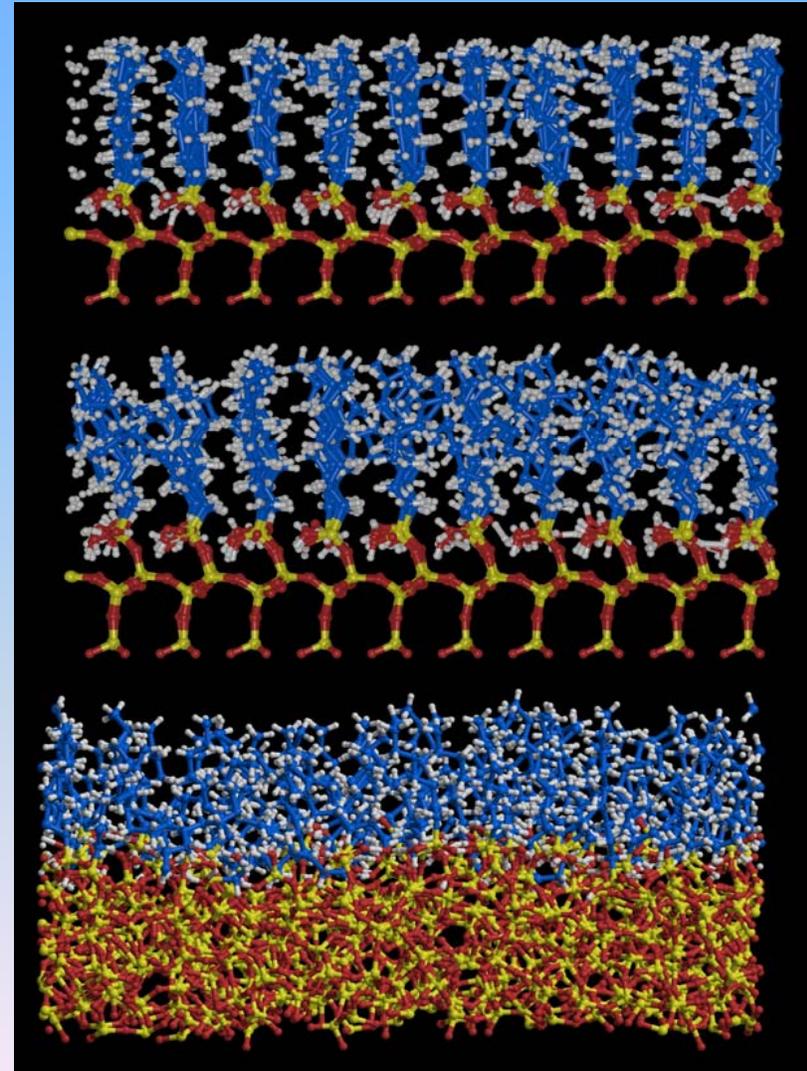


# Simulation Variables

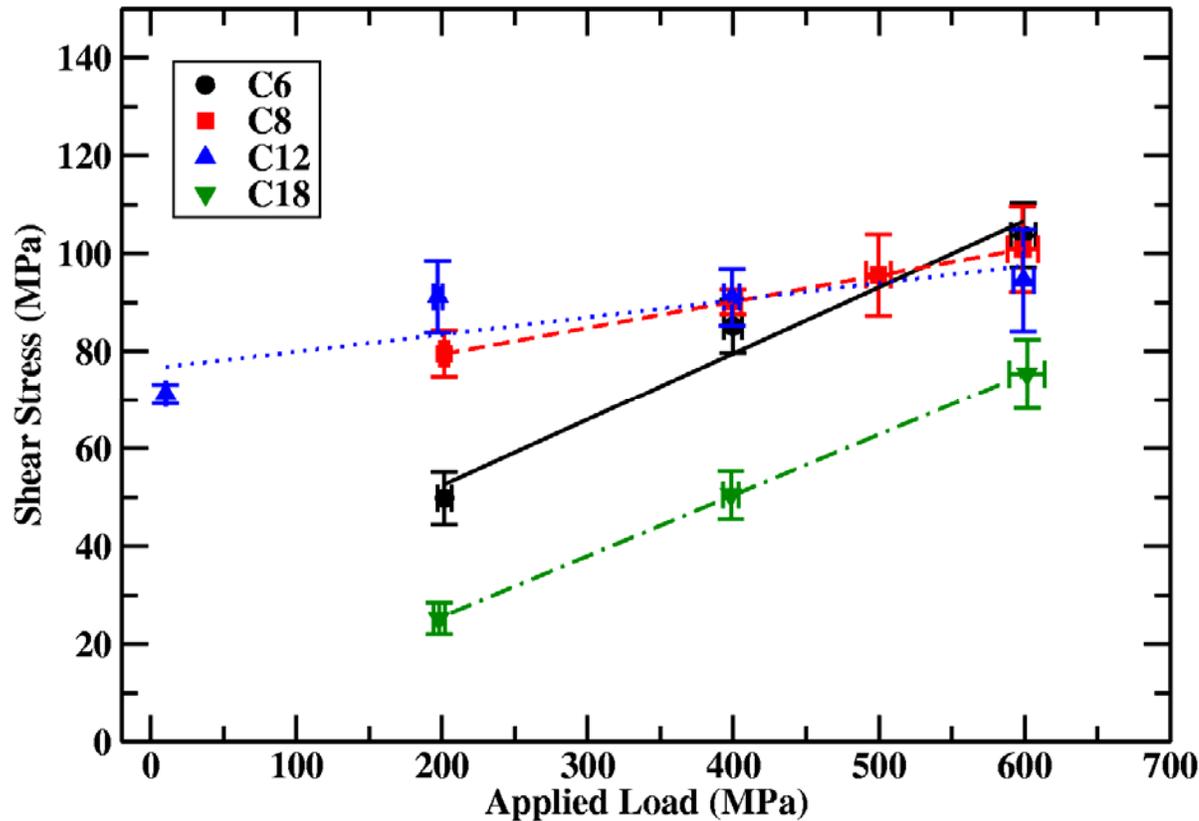
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- Adhesion/Friction between SAMs
  - Pressure/velocity
  - Defects/disorder
  - Chain length
  - Tail group/fluorination
  - Substrate
  - Water



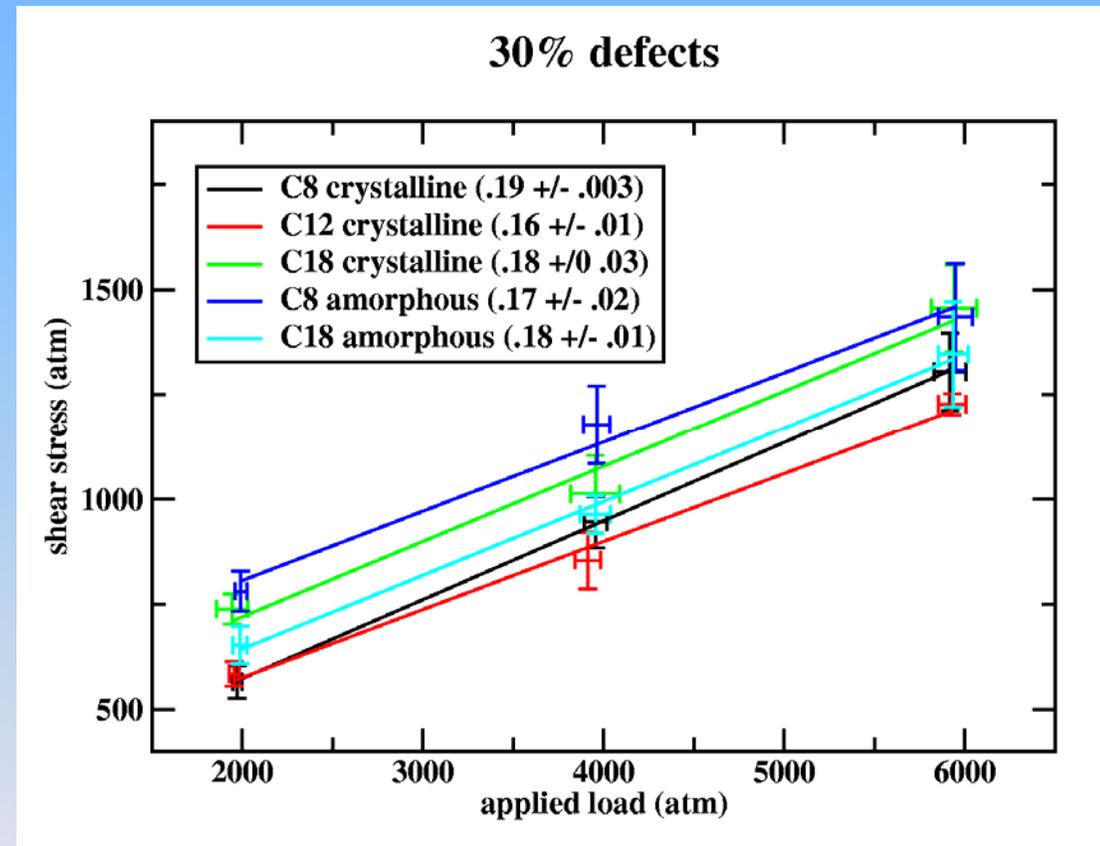
# Major Results



- Well-ordered SAMs
- Friction coefficients  $\mu$  determined from slope
- Non-monotonic chain length dependence

# Major Results

- Defects are not randomly interspersed
- Chain length dependence is native dependence
- Fluorinated chains are highly ordered -> high friction
- Charged tail groups form hydrogen bonds -> high friction
- Odd/even effect confirmed



# Metrology Needs

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- Better characterization
  - AFM tips
  - Samples
- Velocities
- How much water?

Ideally: identify some major well-defined problems that we can all attack.

