CHARACTERIZING SELF ASSEMBLED MONOLAYERS USING SCANNING TUNNELING MICROSCOPY

By Robert Conwell

Advisor: Dr. Lloyd Bumm

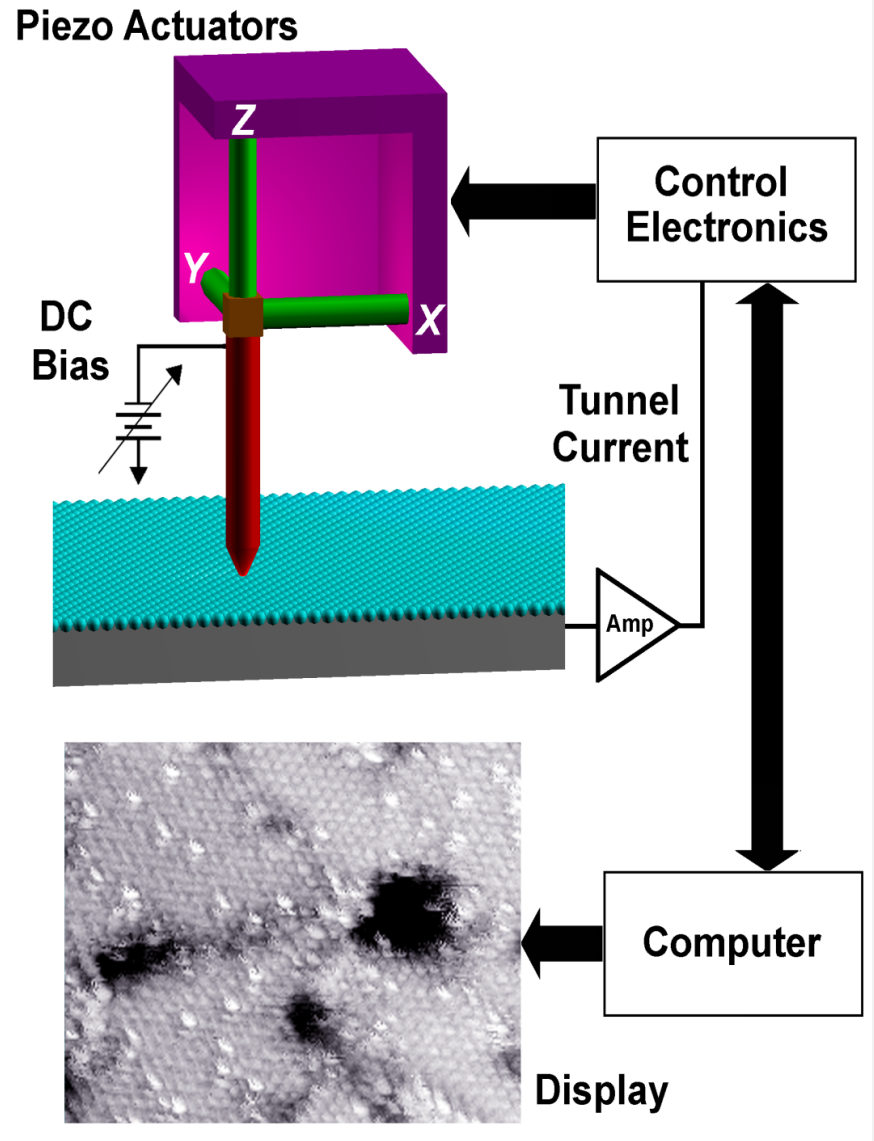
11 June 2019

SCANNING TUNNELING MICROSCOPE (STM) FUNDAMENTALS

- Electrons tunnel from atomically sharp tip to flat conductive sample

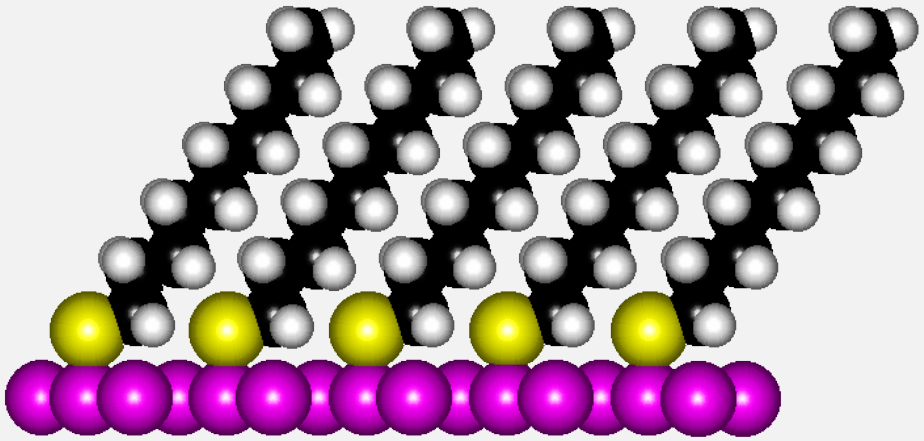
$$I \propto e^{-kd}$$

- Set point current and negative feedback for constant height
  - Low *I*: Tip too far, move forward
  - High *I*: Tip too close, move back
- Images surface topography for homogeneous samples



SELF ASSEMBLED MONOLAYERS (SAM'S) AND ALKANETHIOLS

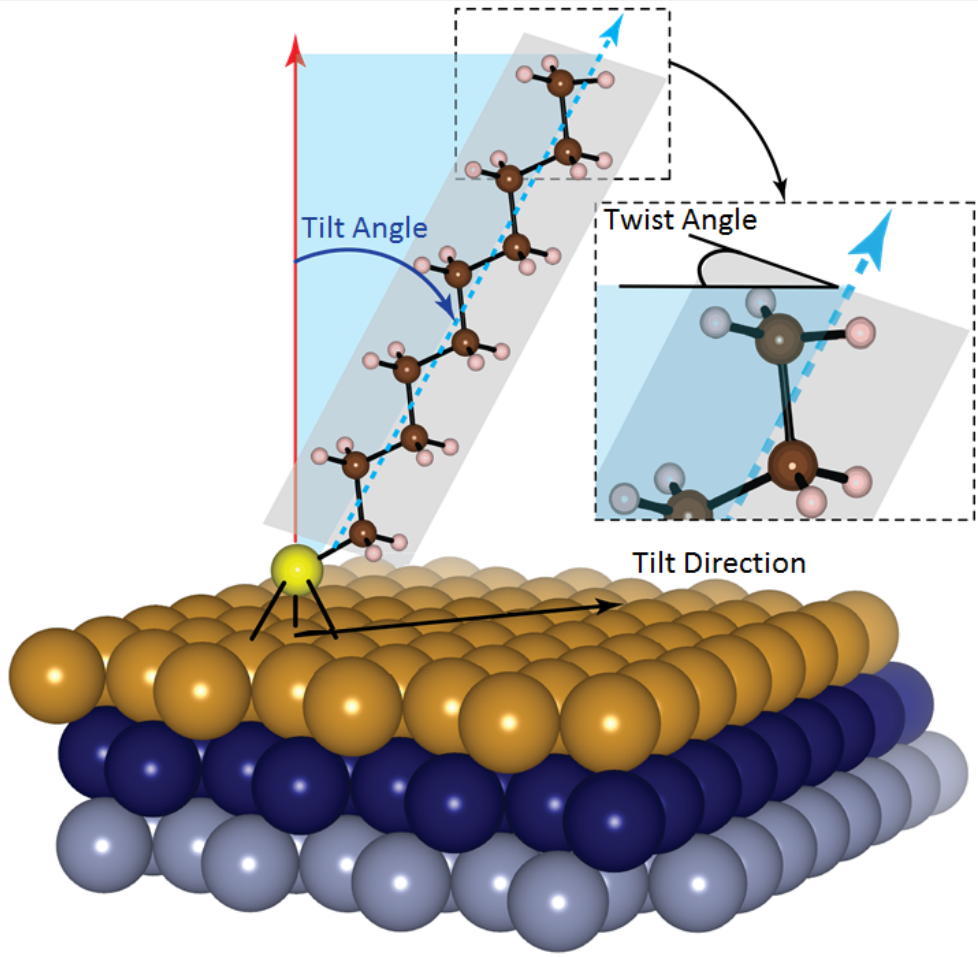
- Studying Alkanethiol SAM's
- Potential applications in organic electronics, lithography, etc.
- **How does bonding affect chains?**
- **How does the sulfur bond to the gold substrate?**

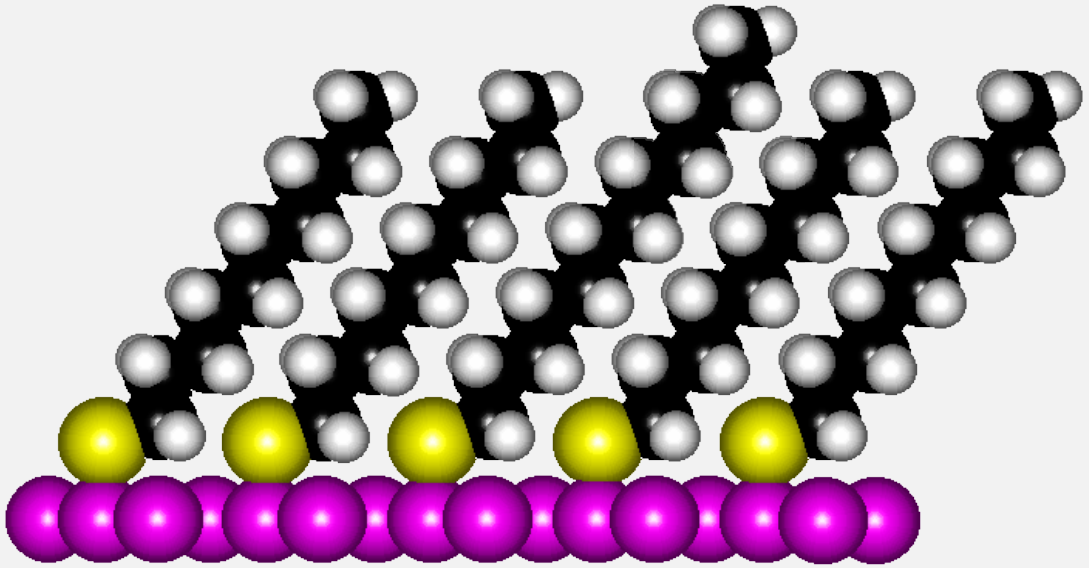


n-Decanethiol (C10)

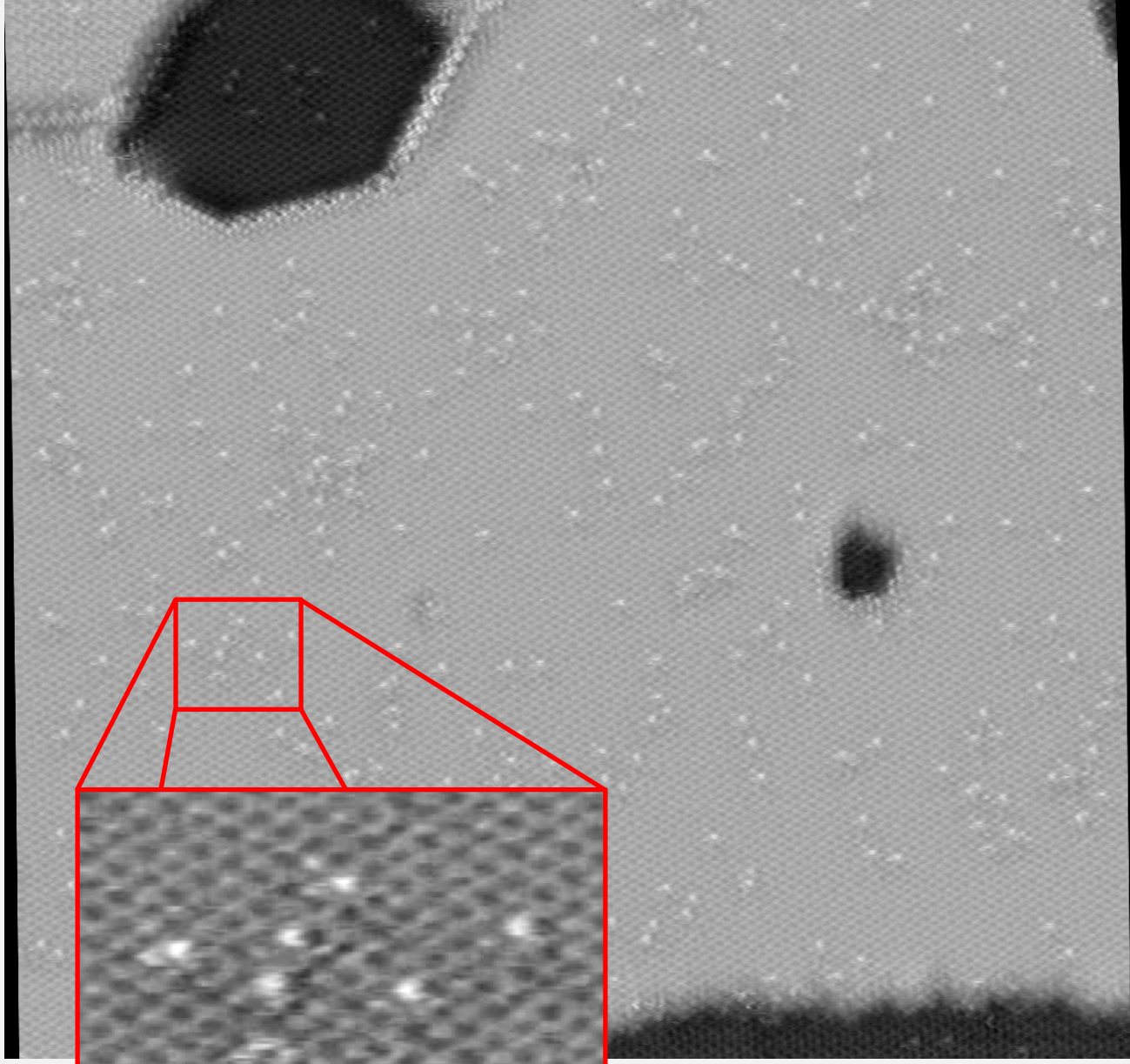
PROPERTIES OF ALKANETHIOL SAM'S

- **How does bonding affect chains?**
  - Chain length, tilt angle and direction, twist angle
- Studying hydro-carbon chains at least 8 molecules long, particularly C10, C11, and C12
- Tilt angle, tilt direction, and twist angle of hydrocarbon chains are determined by gold sulfur bonding





- Mix in longer chains (C12 in C10)
- Image headgroups with STM



C12 guests protrude from C10 host SAM

THANK YOU.
QUESTIONS OR COMMENTS?

HOW IT FITS TOGETHER

- **How does sulfur bond to gold substrate?**
- Use high resolution images from STM to determine chain properties
- Extract real and probable parameters for Molecular Dynamics simulation
- MD Code provides possibilities of how sulfur bonds to the gold substrate to achieve these parameters