Surfaces, interfaces, thin films & single crystal diffraction

Mike Toney (SSRL),
many others: Bao, Bargar, Brown, Chang, Chabinyc, Chianelli, Clemens, Fisher, Fuller, Frisbie, Gilbert, Greven, Lucas, Leisch, McGehee, McIntyre, Nilsson, Pelton, Salleo, Subramanian, Suzuki, Waychunas
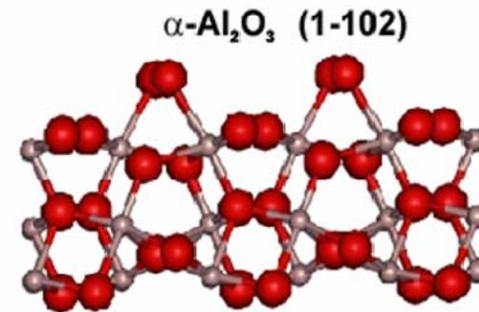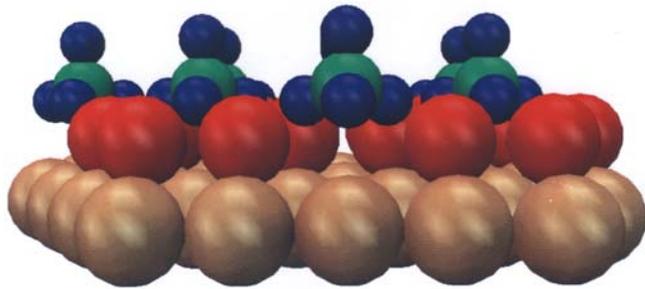
1. Surface & Interface, Thin Film & Single Crystal Science
2. Beam Line Needs and a Solution

Surface & Interface Science

Surfaces and interfaces widespread importance:
- catalysis, e.g., fuel cells (Toney, Leisch, Nilsson, Chianelli)
- minerals and oxides (Brown, Bargar, Waychunas, Gilbert)
- electrochemistry (Lucas, Toney, Leisch)

α-Al_2O_3 (1-102)

What is interface atomic structure and how does this affect reactivity?
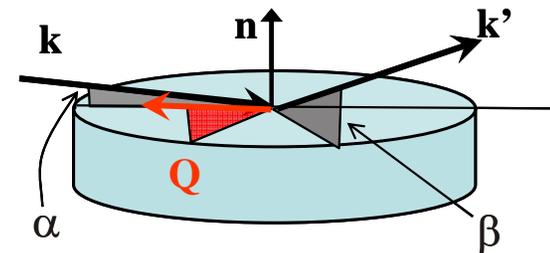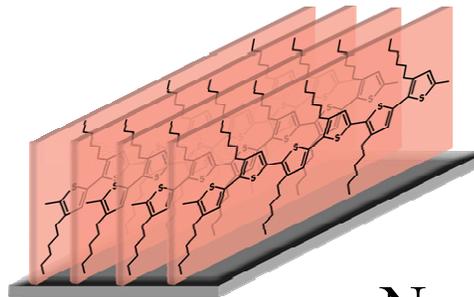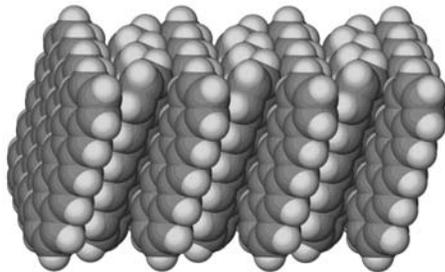
Need:
- intensity (brightness)
- flexible manipulation of sample orientation
- ability to hold cells and sample chambers
- rapid data acquisition

Thin Film Science

Thin films widespread importance:

- organics, e.g, for transistors, solar cells (Chabinyc, Bao, McGehee, Salleo, Subramanian, Frisbie, Fuller)
- inorganics, e.g, electronics, magnetics (Chang, McIntyre, Clemens, Suzuki, Salleo, Pelton)
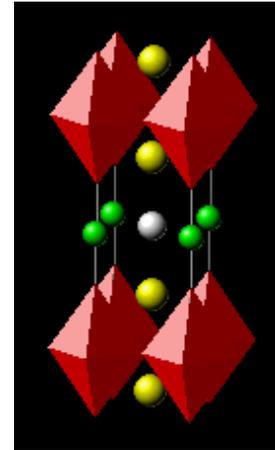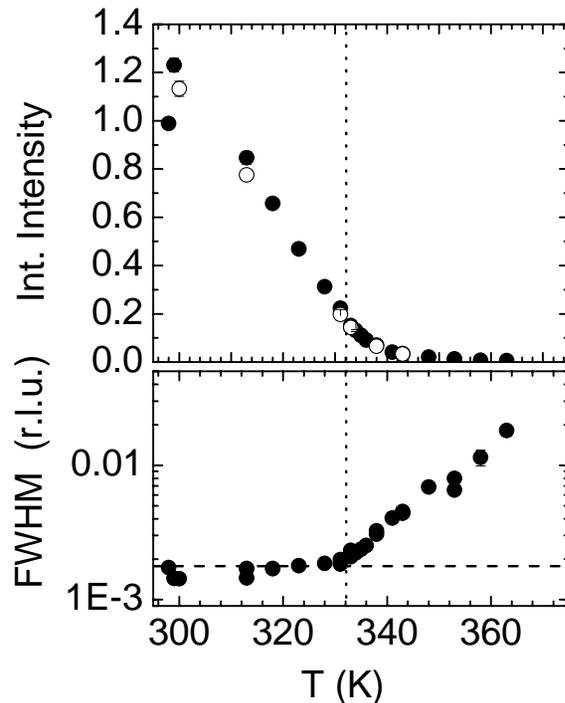

Need:
- intensity (brightness)
- ability to tune penetration depth
- small α but large β (Qz)
- simultaneous Qz data collection
- ability to hold environmental chambers

What is atomic/molecular structure of film and how does this affect properties?

Single Crystal Science

Single crystal properties important:
- physics, e.g. high Tc, phase transitions (Fisher, Greven)

Understand physical (electronic, superconducting) properties

Need:
- intensity (brightness)
- high resolution
- ability to hold cryostats & furnaces without interference from diffractometer

High Resolution Diffractometer

- high brightness
- approximately 5-30 keV
- BL 7-2
- Psi/8-circle
  - accurate sample alignment
  - flexible detector scans
  - ability to hold displex & other reactors & chambers
  - different detectors:
    - crystal analyzer
    - fast 1D PSD
    - small area detector