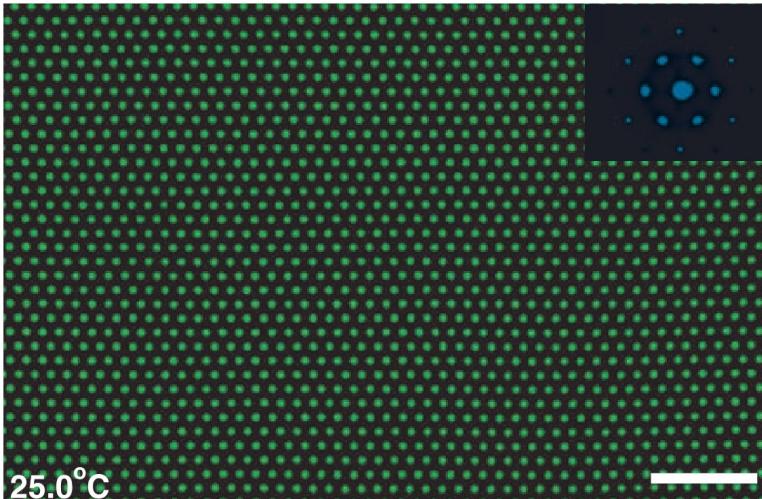
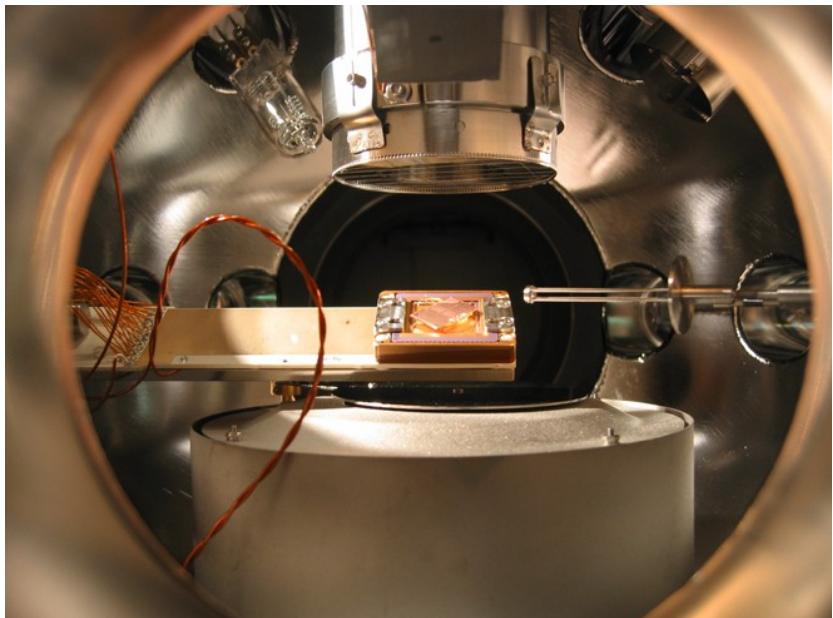
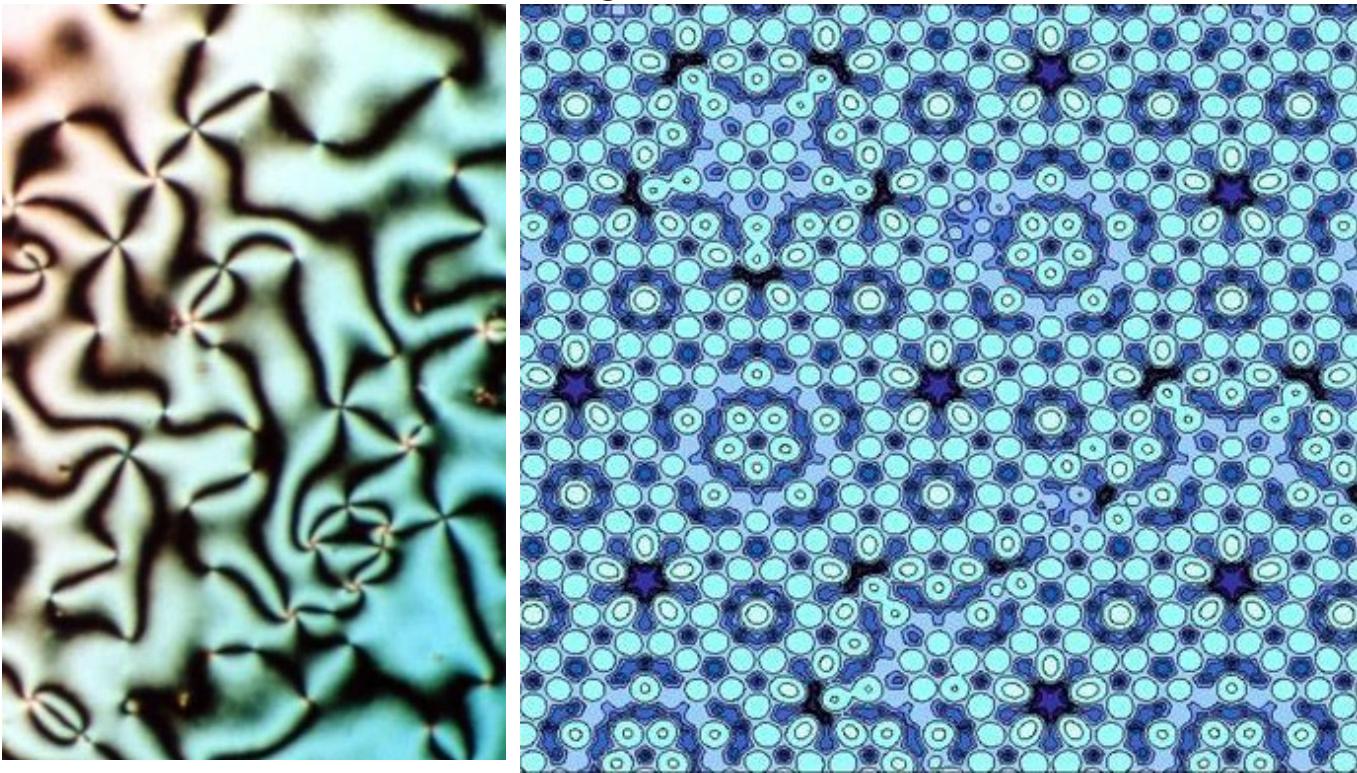


# Crystal Growth Methods and Mechanisms

## Ian McDougall

# What makes a crystal?

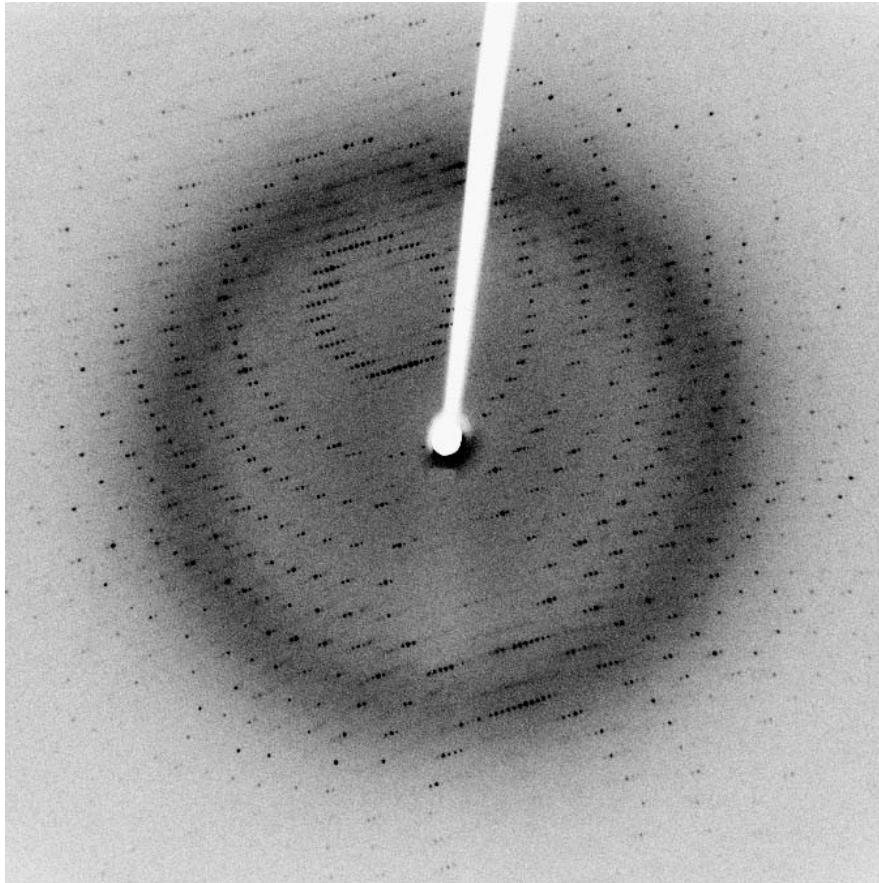
- Ordered
- Exotic variations:
  - Aperiodic
  - Liquid
  - Colloidal
  - Time crystals



**Fig. 1.** Bright-field image of the NIPA particle colloidal crystal showing no defects; the slice is of the seventh layer from the cover-slip. Each bright spot corresponds to the central region of a 0.75- $\mu\text{m}$ -diameter particle. Because of sample preparation and annealing, the primary defects are partial dislocations that exist in the interior of the crystal. Scale bar, 5  $\mu\text{m}$ . (Inset) Bragg diffraction (wavelength = 405 nm) of the same sample.

# Why study crystallization?

- Separation
- Fouling
- Characterization
- Production

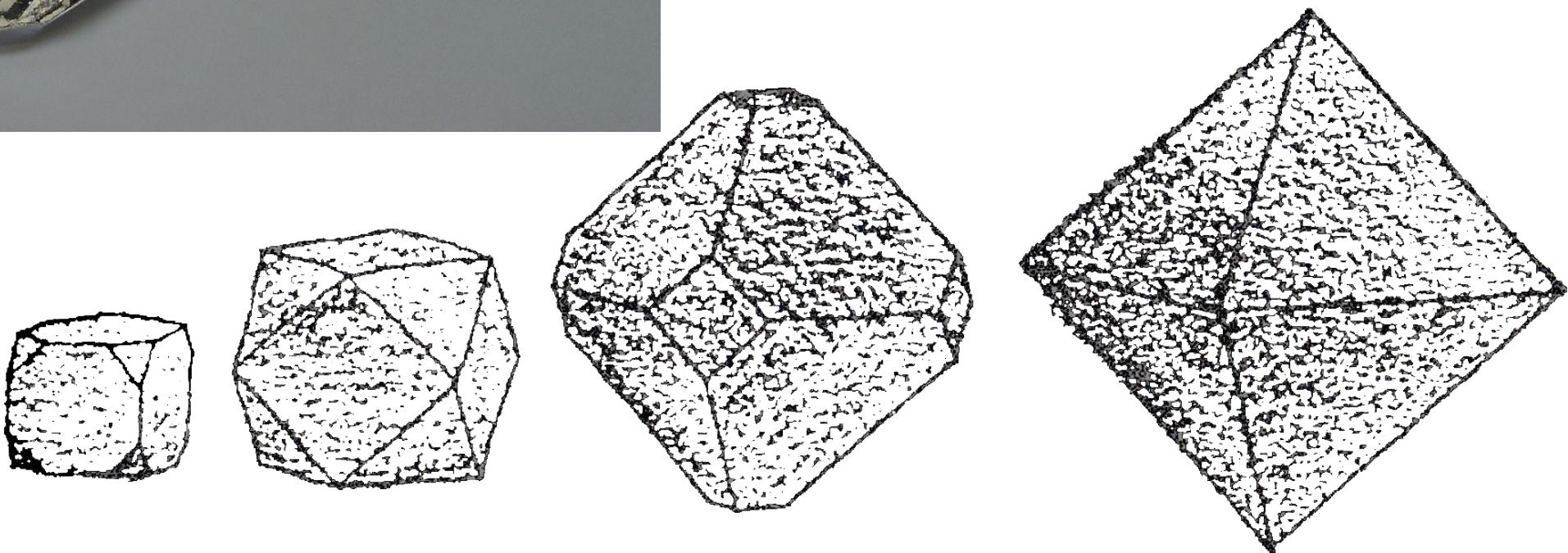
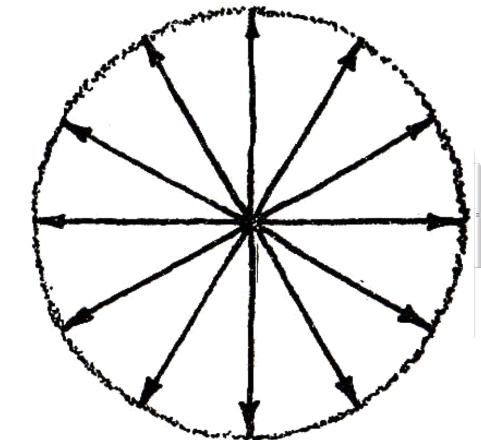
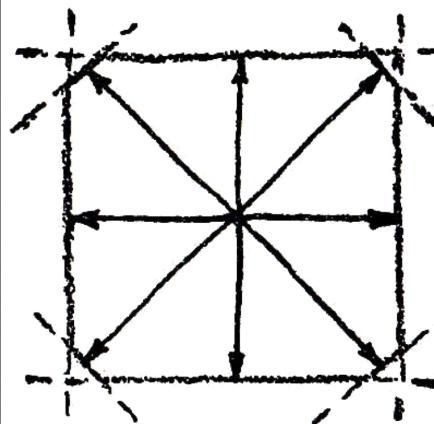


# How do you grow a crystal?

- Solid growth
  - Annealing
  - Gel growth
  - Whiskering
- Melt growth
  - Freezing
  - Kryopoulos, Czochralski, and Bridgman techniques
  - Floating zone
- Growth from solution
  - Precipitation
- Vapor growth
  - Deposition
  - Vapor transport
  - Precipitation
  - Vapor-Liquid-Solid
- Other Considerations
  - Biomineralization
  - Naturally formed
  - Microgravity

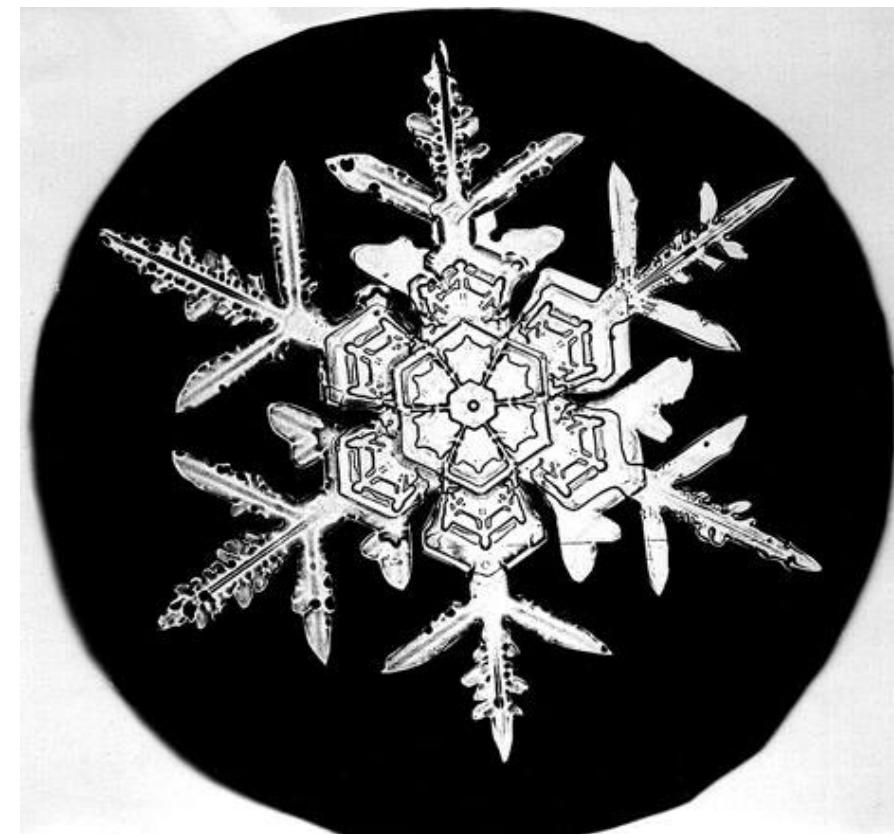
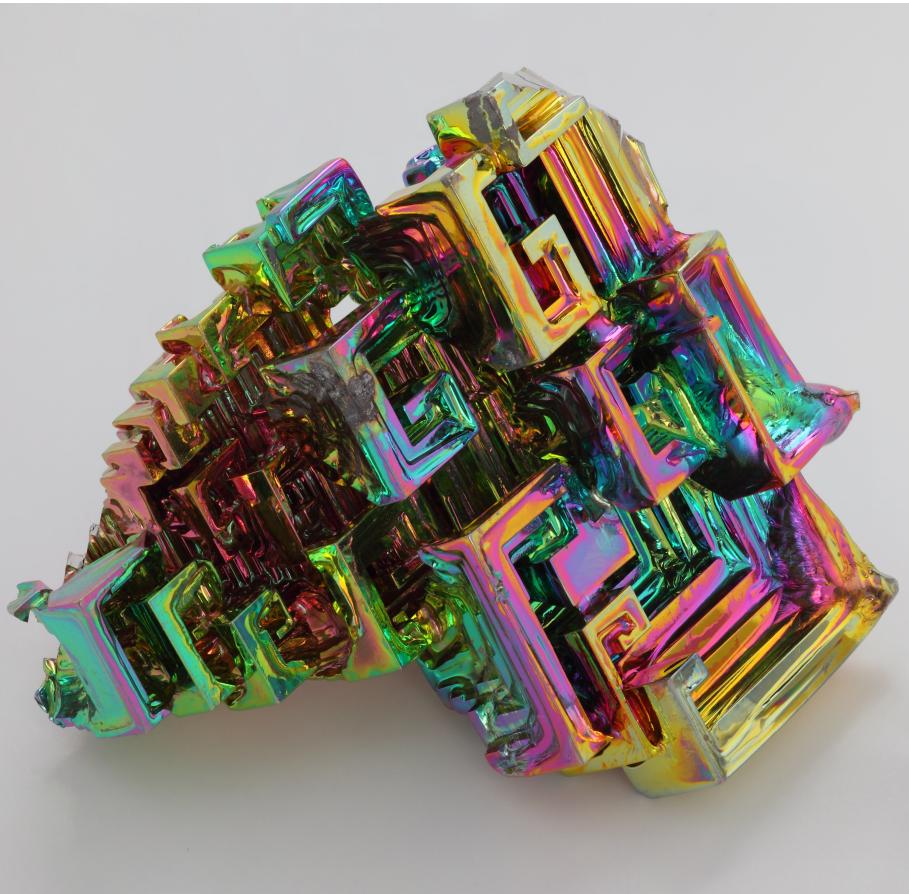
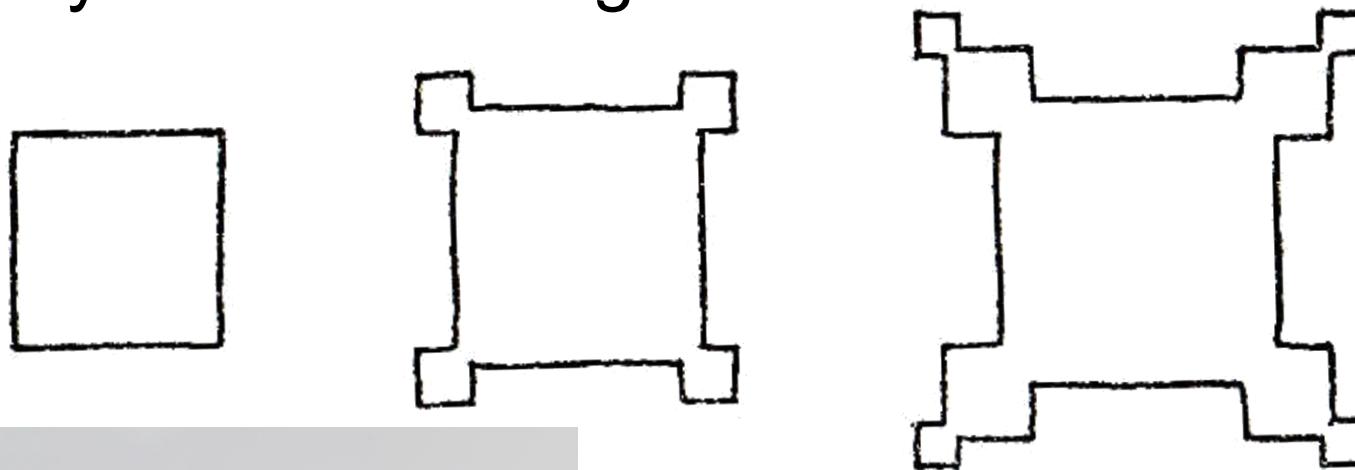
# Crystal Growth Habits

Caused by anisotropy of growth rates.



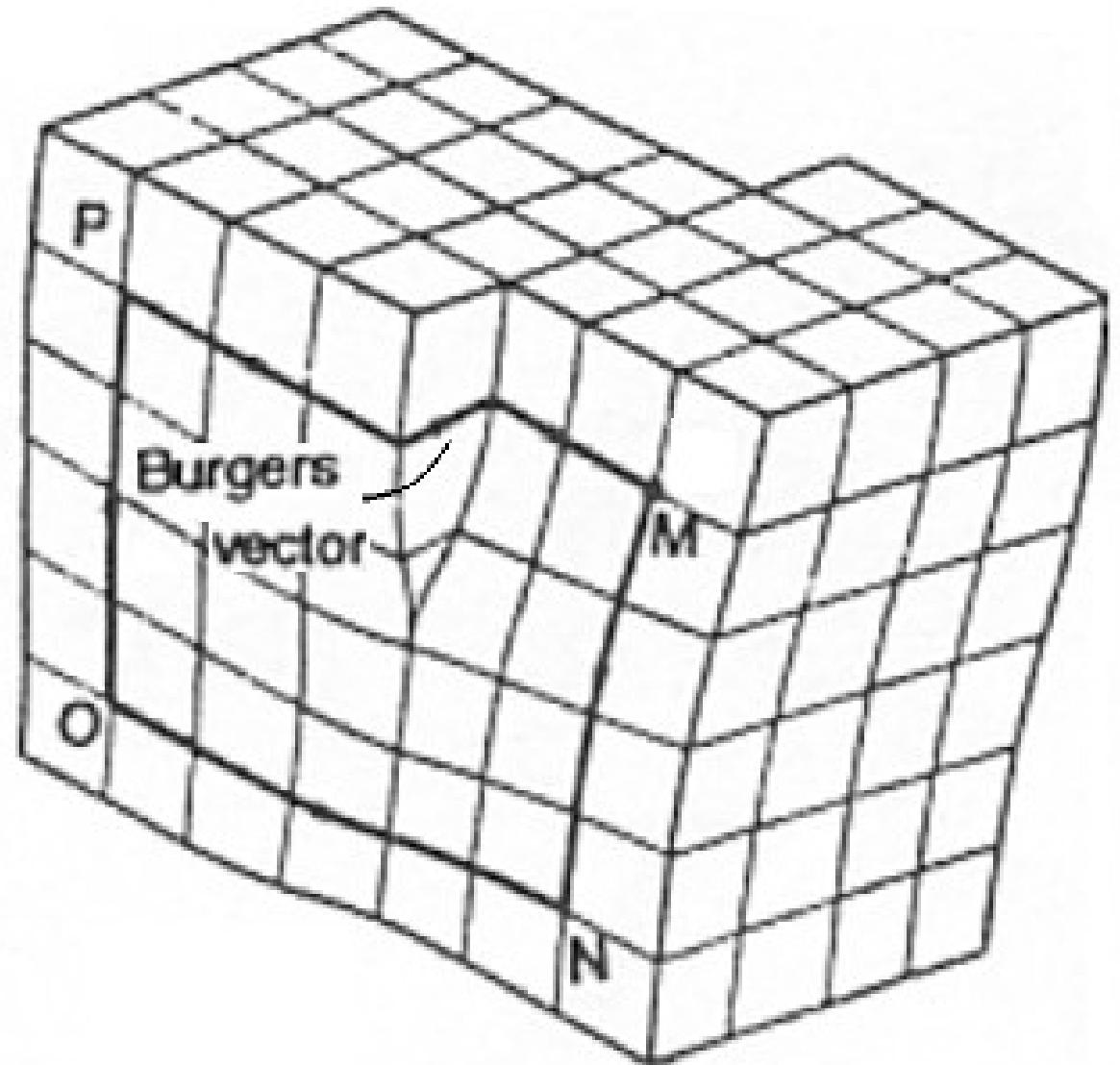
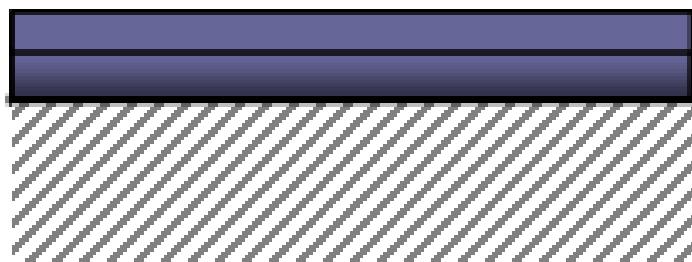
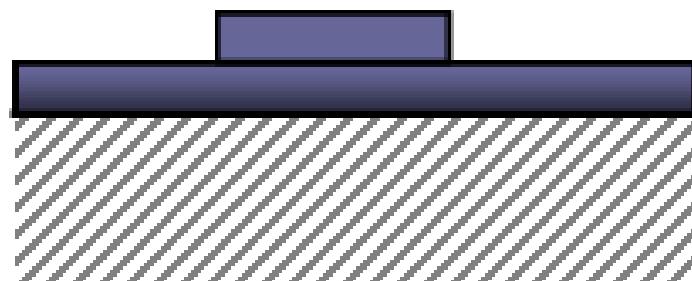
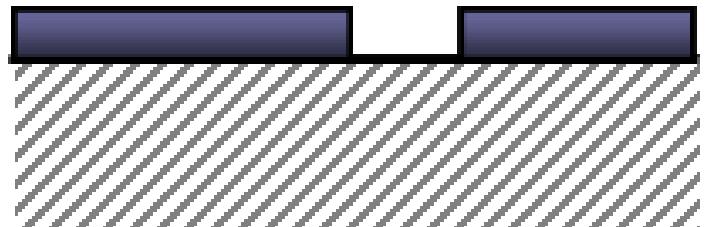
# Hoppered and Dendritic Growth

Caused by concentration gradients across a surface.

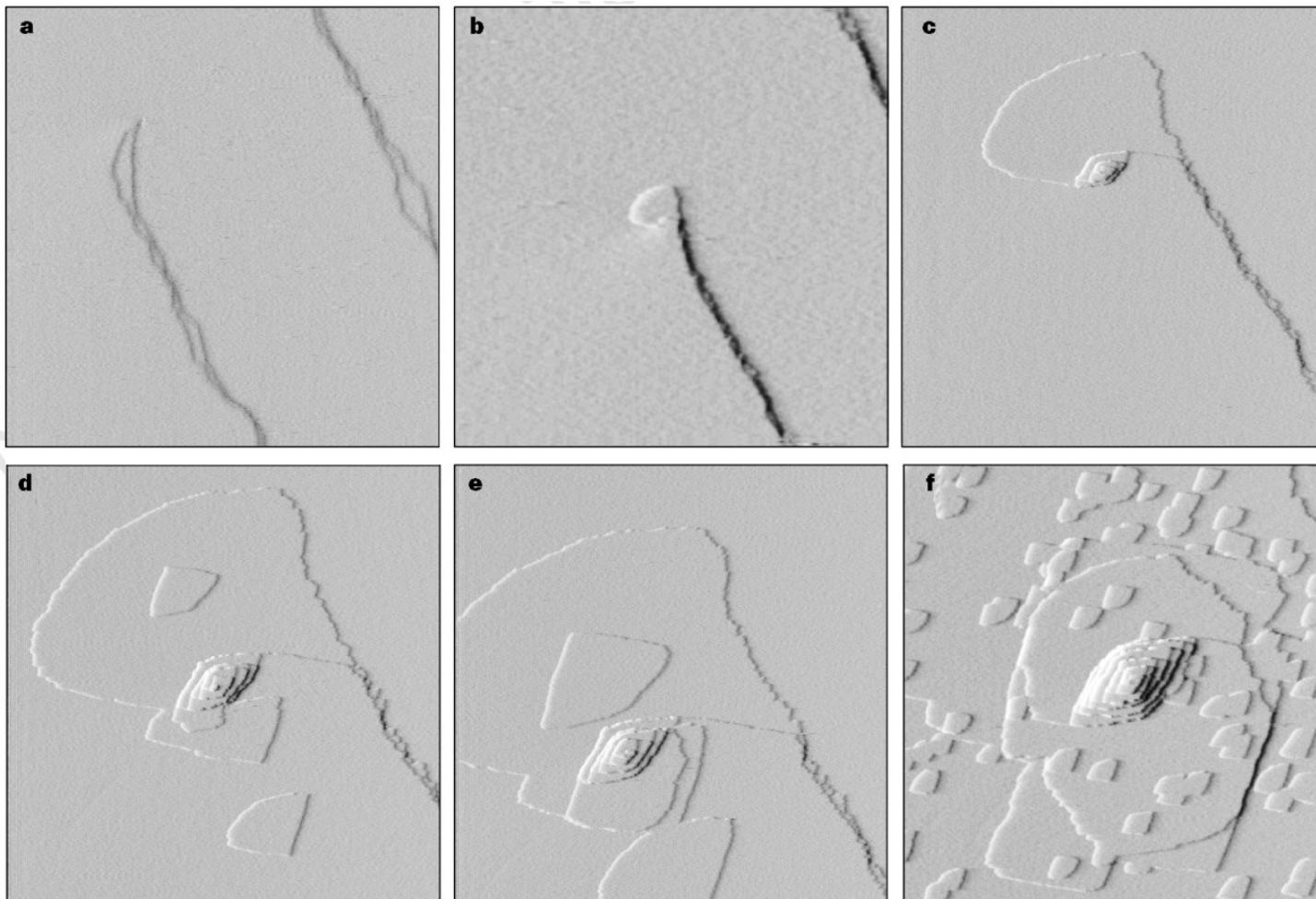


# Epitaxial and Spiral Growth

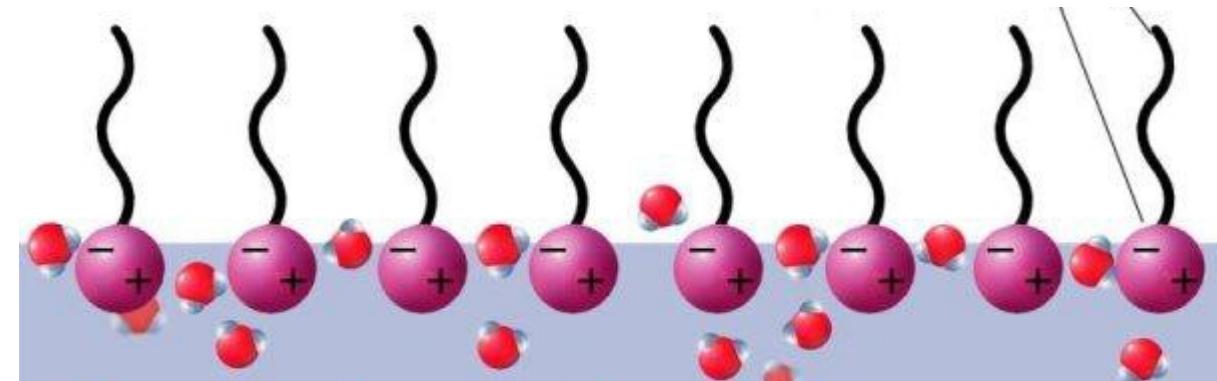
Burton-Cabrera-Frank theory



# Proposed Research



AFM observation  
of spiral growth



Gold-functionalized  
Langmuir-Blodgett  
film

**Questions?**