ARISE Week 1

Joel Grayson

What We Did

- Trained on how to create crystals by melting powder (starting with TIPS-ADT) on the hot bench, use vacuum storage, and operate the microscope.
  - Objectives
  - Cross vs. linear polarization
- Experimented with TTF to find which factors create the best twisted crystals.
  - After two experiments in which it was easy to create crystals, my TTF was replaced with another TTF sample that was harder to crystalize. Therefore, I repeated the first two experiments.

TTF Experiment 1: Melting Temperature

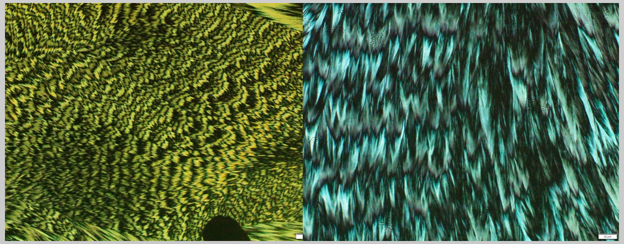
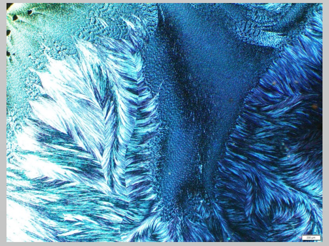
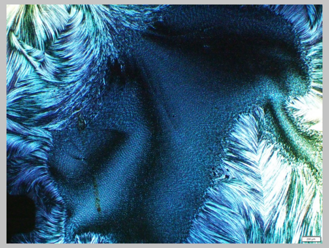
Methodology

Melted TTF crystals at three different temperatures. Then, waited for them to crystalize at room temperature without pressure.

Conclusion

- Best melting temperature: 180°
- More irregularity at lower melting temperatures
    - Reason: abietic acid has not melted yet, so proper spherulites do not form.
- Longer pitch at lower melting temperatures
    - Reason: abietic acid helps it twist, but it is not melted at the lower temperatures
- Color wavelengths decrease at hotter temperatures
    - Reason: unknown

Results

Temperature	Observations	Photo
160° (below melting point)	•Few twystals •P1 morphology •Blue, green, and yellow	
170° (around melting point)	•Few twystals •P1 morphology •Color: blue	
180° (above melting point)	•Most numerous and large twystals. •P1 morphology •Color: Blue and green	

TTF Experiment 2: Cooling Temperature

Methodology

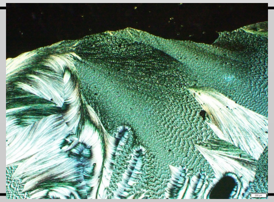
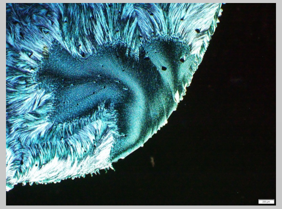
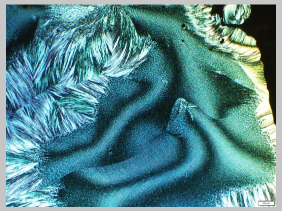
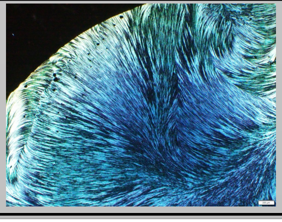
Melted TTF crystals at 180°. Then, waited for them to crystalize at three different cooling temperatures without pressure.

Conclusion

- Best cooling temperature: 75°
- Cooler cooling temperatures lead to larger pitches.

    Possible reason: At cooler cooling temperatures, the fibers grow quicker. If the fibers twist at a constant rate per second, then there will be fewer twists per unit of distance if they are growing slower, leading to a longer pitch.

Results

Cooling Temperature	Observations	Photo
Room temperature (control)		
50°	One twystal	
75°	Many twystals	
100°	No twisting, so I did not do 10x and 40x objectives.	

TTF Experiment 3: Pressure

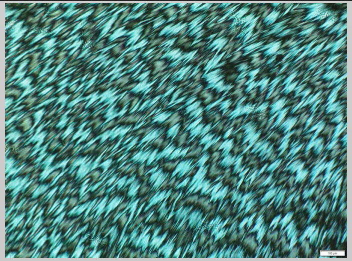
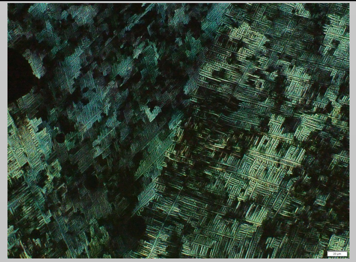
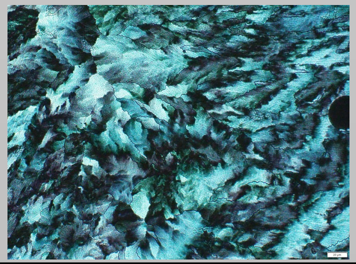
Methodology

Melted TTF crystals at 180°. Then, waited for them to crystalize at 75° with three different pressures.

Conclusion

- Only the no-pressure sample twisted. The other samples had crystals, but they looked visually different and did not twist.
    - Theory for why: At higher pressure, they can only expand but not move around because they are pinned down. At lower pressures, they have enough wiggle room to twist.

Results

Pressure	Observations	Photos
No pressure (control)	Twisted crystals	
Tweezer/spatula	Rectangular grid within the crystals	
White block	Weird-shaped crystals	

What I Learned

- Morphology - concerned with the structure of something
- Spherulite
- Nucleation center
- Grains
- Fibers
- Microscopy - study of the use of microscopes
- Tools
    - Hot bench
- Band - one color circle
- Pitch - period
- Luminescence - emitting light (not after heated)
    - Phosphorescence - light emitted without radiation (long-term)
    - Fluorescence - light immediately emitted after absorption (short-term)
        - Emits longer wavelengths that incident radiation
            - (Incident=incoming) radiation - light that hits a material
    - Photoluminescence - emitting light after absorbing light
- Incandescence - emitting light as a result of heat
- Substrate - glass piece (material deposited on to)
- PXRD - powder X-ray diffraction
- Charge transfer complexes (CTC) - group of 2+ substances stuck together because of a (charge transfer=one was oxidized -electron→ one was reduced)
    - ground-state CTCs (GSCs) and excited-state CTCs (exciplexes)
    - Uses: OLEDS, OPV (organic PV)
- Spectroscopy - study of absorption and emission of light by materials
- Crystallography - study of structure and properties of crystals
- Photoswitch - molecule that changes its orientation upon being irradiated
- 5 carats - 1 gram
- Spherulite - area within the grain boundary
- Grain
- Film - thin layer
- System - molecule + additive (e.g. TIPS ADT + Polyethylene)
- Optoelectronics - study concerned with the behavior between light and electronics. How electronics emit, detect, control, or manipulate light.
    - Fiber-optic cables - transmit light over long distances
- Perovskites + organic semiconductors can make solar cells
- Twisting pitch - period length
- The literature - body of published scholarly works and research papers relevant to a particular field of study
- Review (in research) - overview of already existing knowledge and current thinking in a field. No new research data presented.