

Why is any of this important or relevant?

We need more **efficient** and **cheaper** ways to **filter water** as pollution, climate change, and carelessness on the behalf of many large corporations have led to a build-up of contaminants in current water sources, especially in **low-income and predominantly non-white areas**. From the infamous Flint water crisis to the Stop Line 3 movement, clean water has become a **growing environmental justice problem** that needs to be addressed. Using **commercial surfactants**, we look to employ **membrane nano-filtration** to make water filtration more efficient and **more accessible** to all.

Background

What's a surfactant?

- A chemical compound that decreases surface tension/interfacial tension - a **surface acting agent**
 - Usually have a long hydrocarbon tail (hydrophobic) and a polar head group (hydrophilic)
 - They have a **polar end** and a **non-polar end**

What is self-assembly?

- Self-assembly is a **spontaneous process** in which the molecules of the surfactant organize into **specific ordered structures**

Let's explore why this happens...

- When we put surfactants into an aqueous solution, they tend to reorganize and **aggregate into disc-like or rod-like micelles** so that the polar ends are pointing out at the water while the non-polar tails are put in the center
- These structures of organized micelles forms the **lyotropic liquid crystalline mesophases**
- Lamellar mesophases** are made of **disc-like micelles**
- Hexagonal mesophases** are made of **rod-like micelles**
 - The spaces between the rod-like micelles have a direct path for ions and molecules to travel - like contaminants
 - The pore size is thus very important to what can be filtered out

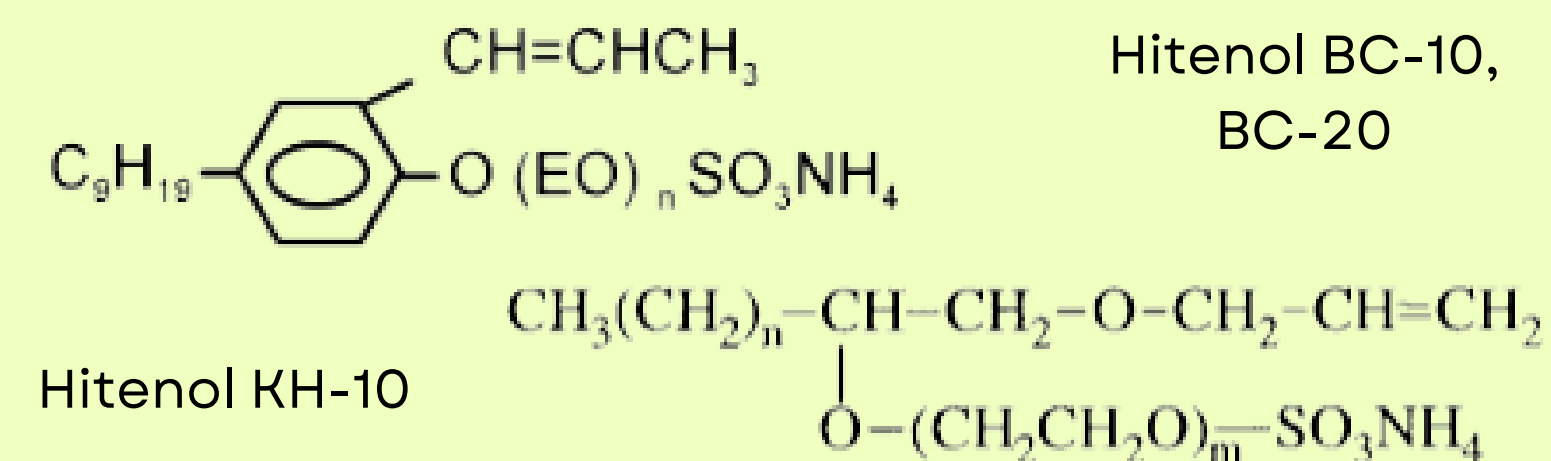
How do we turn these nanostructured gels into handle-able films?

- Polymerization!
- We use **photoinitiated free radical polymerization** using cross-linkers
- Using the mesophase as the template, we cement that structure by crosslinking the gel so that the mesophase is maintained in a film

Using Self-Assembling Surfactants to Form Water Filtration Membranes

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Materials

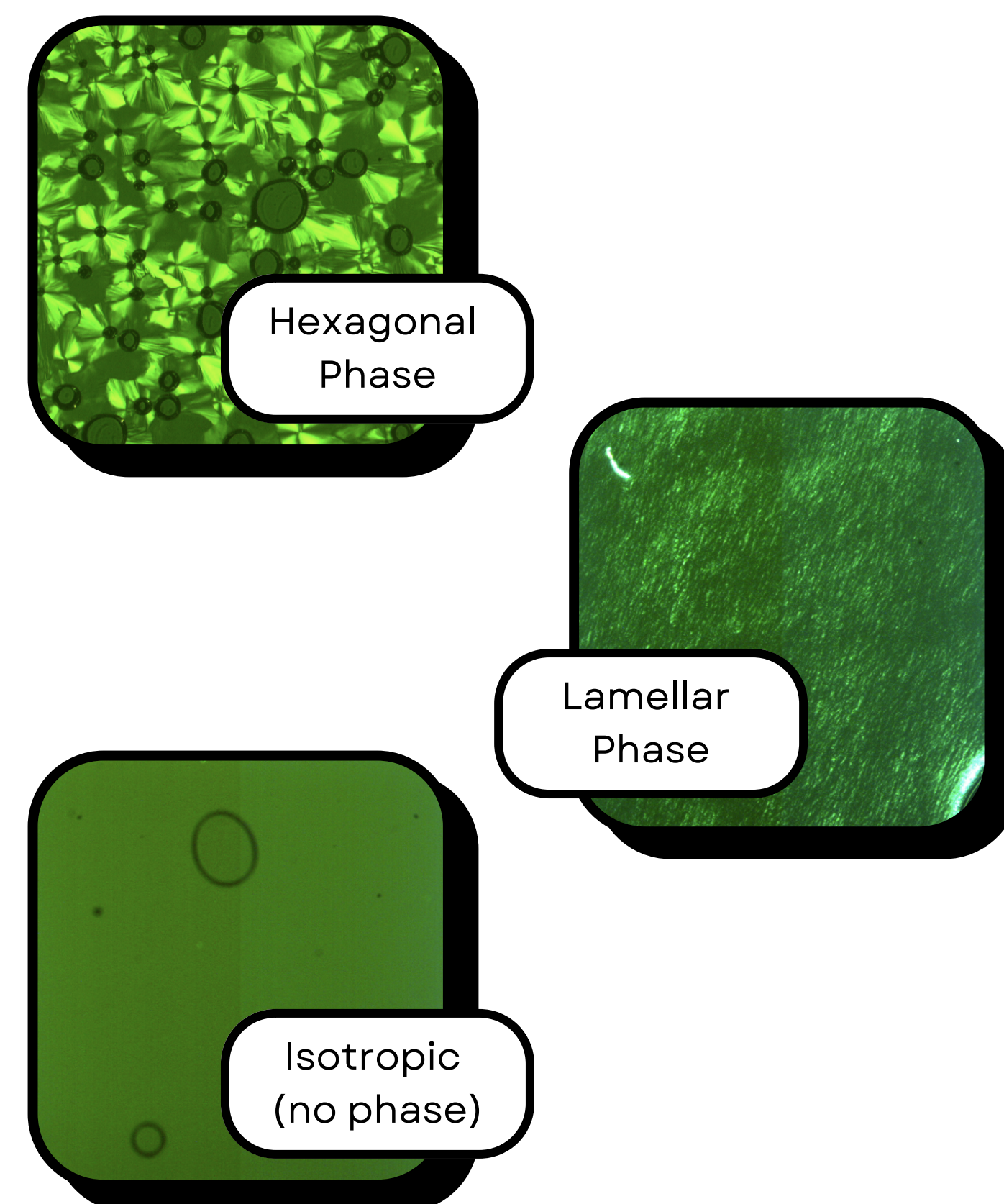


- Water
- XL (HDDA, BDDA)
- Photoinitiator (TPO)
 - Centrifuge machine
 - Polarized light microscopy
 - UV box

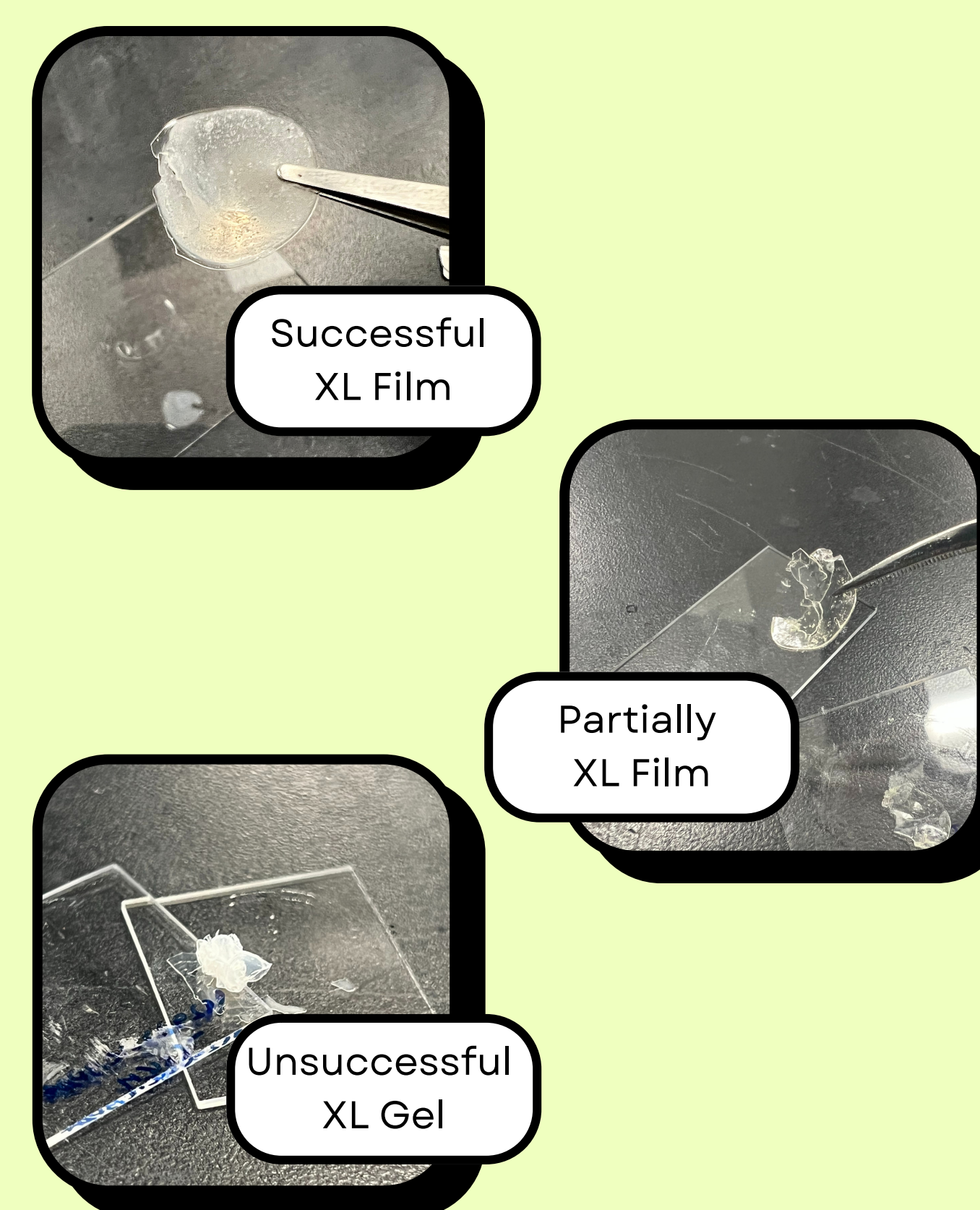
Procedure

- Label centrifuge tubes
- Put amounts of surfactant, solvent, and XL mix (measure using balance)
 - Each XL mix is made by mixing the necessary amount of PI and XL in a separate vial
 - Then vortex the vial until fully mixed
- Centrifuge and physically mix with a thin syringe until fully mixed (typically 14500 rpm or 3000 rpm for 10-15 minutes, 3x)
- Put gel on microscope slides
- Check under POM
- Place in UV box, turn on nitrogen and UV light, and leave for at least two hours
- Remove and check under POM
- Push two slides apart by slipping a razor blade between the two slides
- Attempt to scrape off the film in one piece using the blade

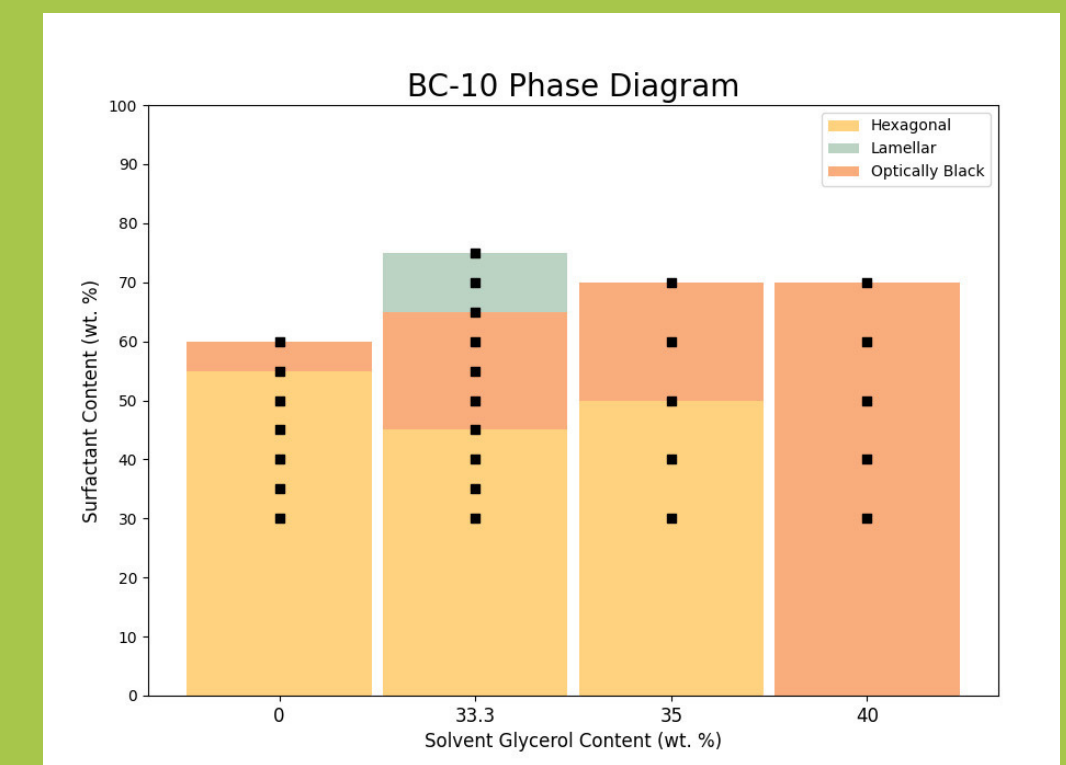
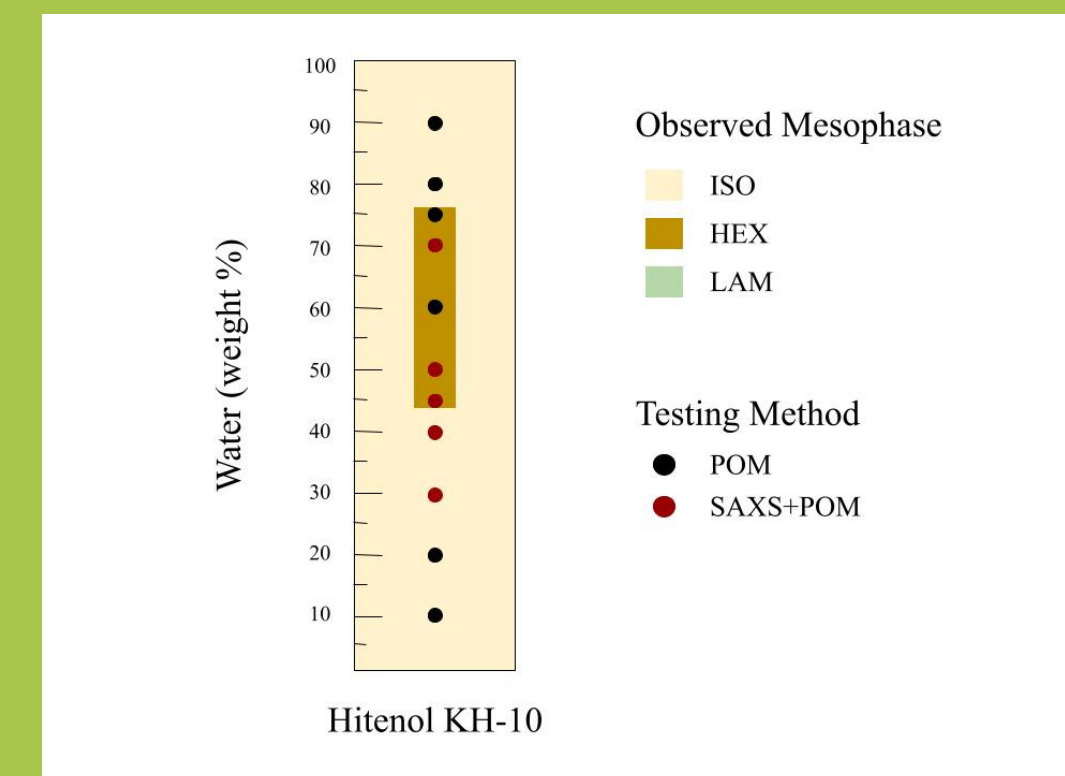
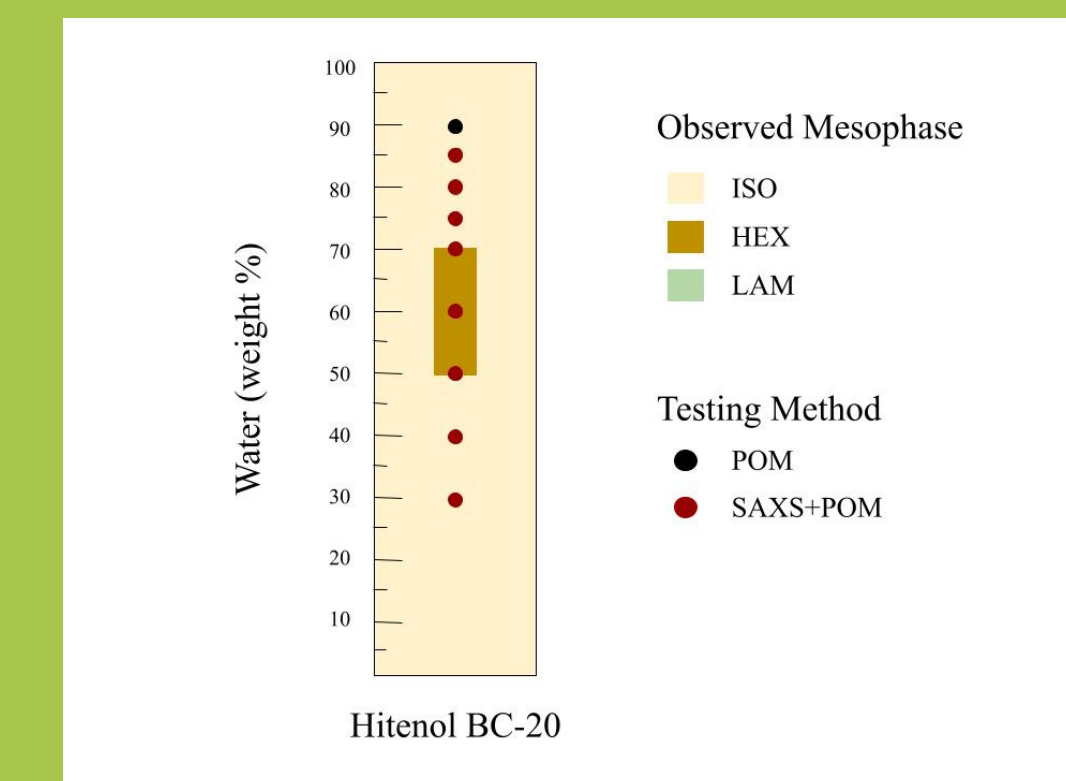
POM Photos



Films



Phase Diagrams



Phases confirmed by SAXS

Conclusion

While we weren't able to create a successful film that has the proper mesophase with the surfactants present, we were able to learn much about the phase behavior of these surfactants. Since the proper phase can't be maintained and the pore sizes are much too big for filtration, we can instead attempt ion conductivity with any successful films.

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