We use self-assembling systems, mainly lyotropic liquid crystals (LLCs), to fabricate hierarchically structured, functional materials. The long-range orientational order and sometimes also positional order of LLCs makes them an ideal starting ground for the production of nanostructures, while the fluidity of the LLCs allows for an easy handling and the manipulation of the produced material’s macroscopic structure. Our research interests comprise the investigation of new LLC systems as starting materials, the synthesis of nanostructured materials and the analysis of their properties as well as functionalities.

**Ordered Mesoporous Materials**
- surfactant
- water
- lyotropic liquid crystal
- hybrid material
- mesoporous silica material

Simplified schematic of true liquid crystal templating (TLCT)

|-----------------------------------|-----------------------------------|-----------------------------------|---------------------------|----------------------------|-------------------------|--------------------------------------|-----------------------------------|--------------------------------------|

**Polycondensation reaction of the silica precursor:**

\[
\text{Si}(\text{OH})_4 + n \text{ H}_2\text{O} \rightarrow \text{SiO}_{2n} + 4n \text{ H}_2\text{O}
\]

**Possible Theses’ Topics**

**LLC phases of block-copolymers:**
- Screen amphiphilic polymers designed by the Adams group for their LLC properties
- Record LLC phase diagram(s) by means of POM and DSC
- Characterize structures of LLC phases by SAXS

**Macro/mesoporous silica materials:**
- Prepare silica materials which contain both macro- and mesopores by combining TLCT and polystyrene particles
- Investigate structure by SAXS, TEM and SEM
- Explore possibilities for selective functionalization and continuous flow processes

**Silification of CNC-films:**
- Fabricate silica/CNC composite films
- Investigate selective reflection by POM, UV-Vis and IR spectroscopy
- Correlate helical pitch to the silica content and preparation conditions

**Characterization Methods**

- Polarizing optical microscopy (POM)
- Small-angle X-ray scattering (SAXS)
- Wide-angle X-ray scattering (WAXS)
- IR and UV-Vis spectroscopy
- Zeta potential measurements
- Dynamic light scattering
- Differential scanning calorimetry (DSC)
- Scanning electron microscopy (SEM)
- Transmission electron microscopy (TEM)