**Motivation and Goals:**
- Leverage UR’s strengths and reputation in advanced materials, optics and photonics
- Promote multidisciplinary research: ChE, Optics, Chemistry, and LLE
- Boost US competitiveness and accomplish DoD missions.

**Why Polarization Control?**
- Communications, imaging, information displays, medical needs, high energy density physics
- Reducing lasing threshold while elevating power output by beam combination
- Laser materials processing, fluorescence polarization and second-harmonic-generation imaging, holography, interferometry

**Glassy Liquid Crystals (GLCs): A Signature Research Program at UR**
- Rod-like moieties as building blocks for nematic and cholesteric liquid crystals
- Passive devices for polarization control, beam shaping, and polarization smoothing underlying laser-based devices
- Active devices for generation of circularly polarized lasers using cholesteric LC devices
- Models for passive and active devices to accomplish polarization of powerful lasers

**Conventional GLAD-Fabricated Helical Coils Exhibit Circular Polarization Inferior to GLC Helical Stacks**
- Light propagation along helical coils
- Round tops, broad spectra
- [LCP–RCP] < 13%

**Robust GLC Materials for Fine Control of Polarized Absorption, Reflection, and Transmission**
- Mixtures of enantiomeric Ch-GLCs enabling tunable stopband from 360 nm through visible to infrared
- Bandwidth monotonically increasing from 60 nm without encountering immiscibility problem
- Circular dichroism representing the differential absorption of left- vs. right-handed polarized incidents

**Mesomorphic Ceramics: Inspired by GLCs for Polarization Control of Lasers**
- **Mesomorphic Ceramics:** inorganic nanostructured solids with sintered liquid crystalline superstructures
- Analogous to GLCs with uniaxial orientation or helical stacking of rod-like building blocks
- Passive devices: robust polarizers and waveplates for industrial or high power (up to 100 kW)
- Active devices: high power laser gain media

**Foundations for Materials Processing**

**Experimental**
- **Nanorods forming lyotropic liquid crystals in isotropic solvents:** Dierking, I.; Al-Zangana, S. *Nanomaterials* 2017, 7, 305.
- **Hairy nanoparticles revealing their brush dynamics and colloidal phase behavior:** Kim, J.U.; Matsen, M. W. *Macromol.* 2008, 41, 4435.

**Theory / Computation**

**Novel Ceramics Processing via Self- and Field-Induced Nanoparticle Assembly**
- **Transition from Molecular to Nanometer Scale**

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