

**Research Title: Synthesis and Mechanical Actuation of Helically Chiral Molecules and Polymer Fibrils**

**Individual Sponsor:**

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**Academic Area/Field and Education Level**

**B.S., M.S. or Ph.D. or B.S., M.S. or Ph.D. candidate in Polymer Chemistry or Organic Chemistry**

**Objectives:**

Design and synthesize helically chiral molecules that can sense changes in viscosity during the curing of optically opaque fluids and can be polymerized as monomers into thermosets and provide in-operando sensing of thermo-mechanical stress evolution during the cure. An extension of this work is to develop synthetic methodologies to form high persistence length helically chiral fibrils that act as embedded fiber sensors in a composite structure.

**Description:**

Helically chiral molecules have been shown to be effective enantio-selective catalysts, exhibit extremely large circular dichroism, and have nano-spring like architectures that have assumed mechanical force absorbing abilities. The goal of this topic is to synthesize helical monomers that impart high temperature performance to thermoplastic and thermosetting resins and to define and implement a synthetic strategy for creating high aspect ratio helical aromatic fibrils. Beyond chemical synthesis, the researcher will evaluate the sensitivity of helical molecules, and polymers to respond to applied strain by optical means (circular dichroism, UV-vis-IR spectroscopy): 1) As non-covalently bound additives in a liquid thermosetting resin; 2) Covalently bound as monomers formulated into a thermosetting resin; 3) As high persistence length helical aromatic fibrils formed from polystyrene aromatic precursors. The researcher will work closely with molecular modelers to define molecular/macromolecular design as it impacts the sensitivity of helical materials to applied strain. A critical part of the research effort will be devoted to developing and defining conditions allowing for the enantiospecific synthesis of helical molecules, monomers and polymers.

**Research Classification/Restrictions:**

US Citizens only

**Eligible Research Institutions:**

Any