Investigating the stimuli-responsive and morphological properties of dye incorporated liquid crystalline polymers within unique polymeric templates

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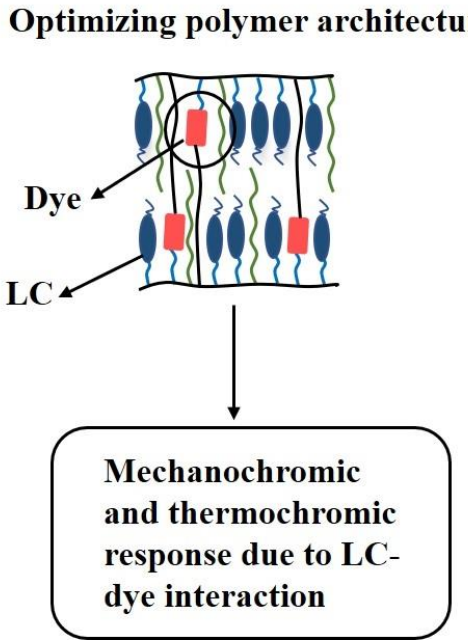
Stimuli-responsive dyes have received significant attention due to their color changing properties upon application of mechanical force/pressure, heat or UV light. Introducing them in processable and flexible polymer matrix can lead to practical applications like mechanical damage sensors, pressure sensors, thermal sensors and crack detectors. Allowing these dyes to interact with structural color exhibiting cholesteric liquid crystalline polymers can create a new hybrid platform of multi-stimuli responsive tunable optical materials. Thermochromic properties of cholesteric liquid crystalline (LC) polymers are well established where their optical properties can be tuned with temperature. To introduce additional functionality to the cholesteric polymers, we have synthesized hybrid mechanochromic dye incorporated cholesteric LC polymers enabling heat and mechanical force/indentation responsive synergistic color response. Molecular engineering of monomers plays an integral role in coupling unique stimuli responsive properties of liquid crystals and dye molecules. Simply tweaking the structure of the monomers within the liquid crystalline polymeric framework induces cooperative interactions between liquid crystalline cholesteric phase (N* phase) and dye molecules. We have successfully shown that these materials can respond to multiple stimuli to tune the color response. These adaptive functional materials with multiple stimuli responsive functional properties can be envisioned for mirrorless lasing, actuators, thermal sensors and photonic applications.



Optimizing polymer architecture to achieve a mechano-thermochromic system