



Optimization of Liquid Crystal Materials

for Photo- and Thermomechanically Responsive Elastomers

Milena Jeżak, Dorota Węglowska, Przemysław Kula, Wiktor Piecek, Jolanta Konieczkowska, Ewa Schab-Balcerzak and Rafał Węglowski

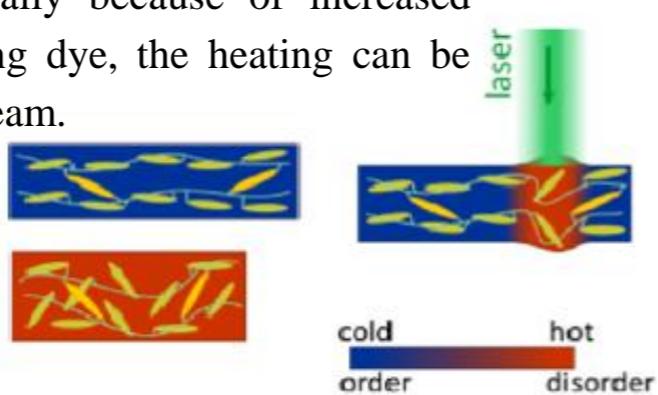
Introduction and the aim of the study

Light- and thermocontrolled liquid crystal polymer networks (LCNs) being tunable photonic switches can be used in several fields of application such as optical communications or sensors [1]. The photomechanical response of such functional materials can be used to convert either thermal or light energy into different forms of mechanical energy [2].



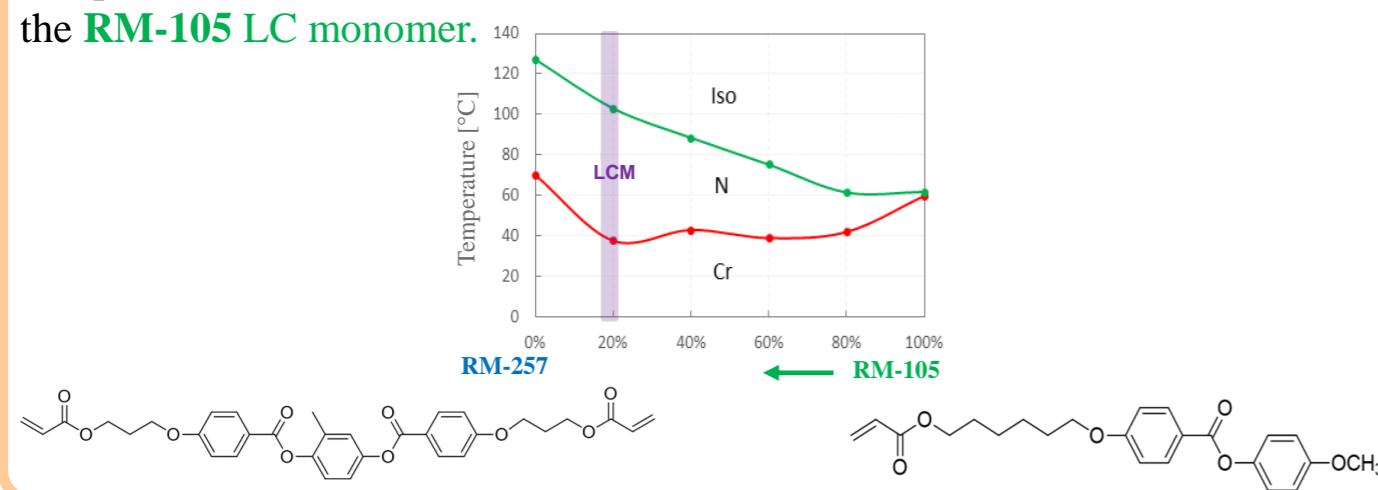
Cross-linked polymer chains (yellow) arranged in one direction in an LC polymer network stripe deform locally because of increased temperature. With efficient light-absorbing dye, the heating can be induced by light absorption from a laser beam.

In this work, we demonstrate the process of the preparation and the investigation of photo- and thermomechanical responded liquid crystalline elastomers.

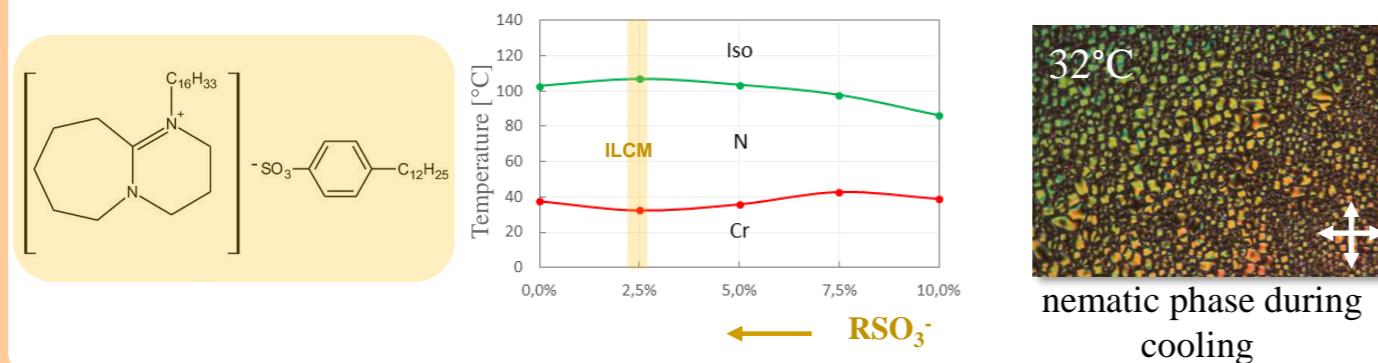


Liquid Crystal Mixture

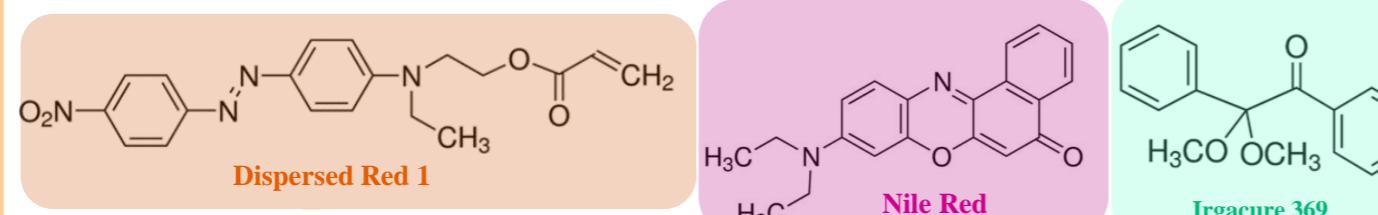
The liquid crystal nematic mixture (LCM) is based on commercially available compounds and contains 80wt% of the **RM-257** LC cross-linker and 20wt% of the **RM-105** LC monomer.



The ionic liquid crystal mixture (ILCM) was prepared by adding 2.5 wt% of the ionic compound **RSO₃⁻** to **LCM**.



The **ILCM** mixture was doped with the dye in amount of 1 wt % (**Disperse Red 1** or **Nile Red**), which provides efficient green laser light absorption and then 1 wt % of the photoinitiator (**Irgacure 369**).



All the compounds were melted and stirred on a hot plate in a glass flask at 80 °C.

REFERENCES

[1] A. Minewicz, et al., *Opt. Materials*, 1, 605 (2003).
[2] K. Dradrač, et al., *ACS Appl. Mater. Interfaces*, 12, 8681 (2020).

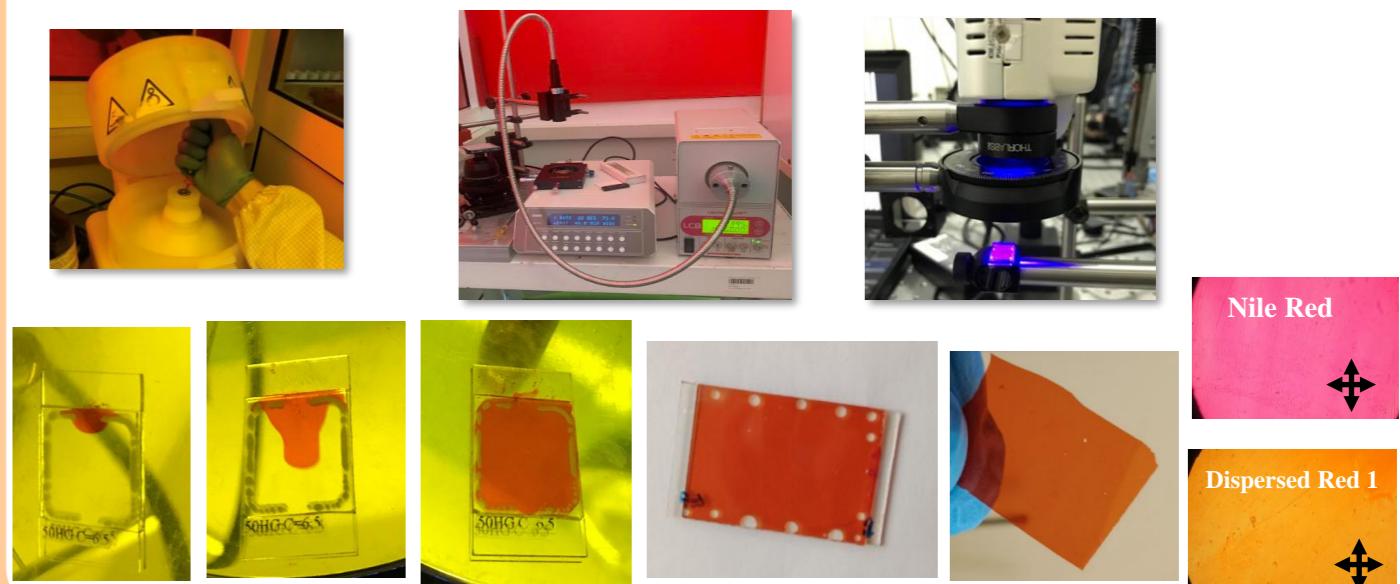
ACKNOWLEDGMENT

This work was supported by the Military University of Technology (UGB 2026 project number 22-094)

Corresponding Author: milena.jezak@wat.edu.pl

Liquid Crystal Polymer Network Film

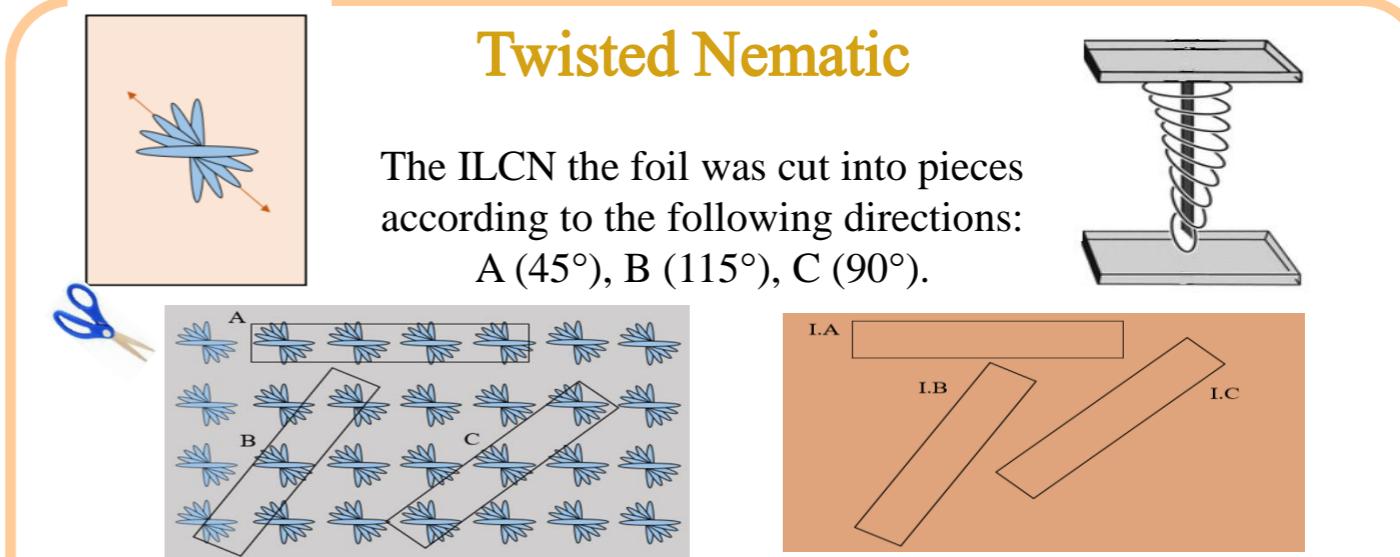
To prepare LCN films, a photoalignment method was used. Glass slides were spin-coated with a photoalignment azopolyimide (JK158) solution (~1%) in N-methyl-2-pyrrolidone, dried, and heated at 130 °C for 2.5 h to evaporate the solvent. The polyimide orienting layers were exposed to linearly polarized UV light with wavelengths in the 345–380 nm band (Hamamatsu LC8 Xe-Hg UV lamp with a Glan-Taylor prism polarizer) with 3 mW/cm² intensity at the glass plane for 40 minutes.



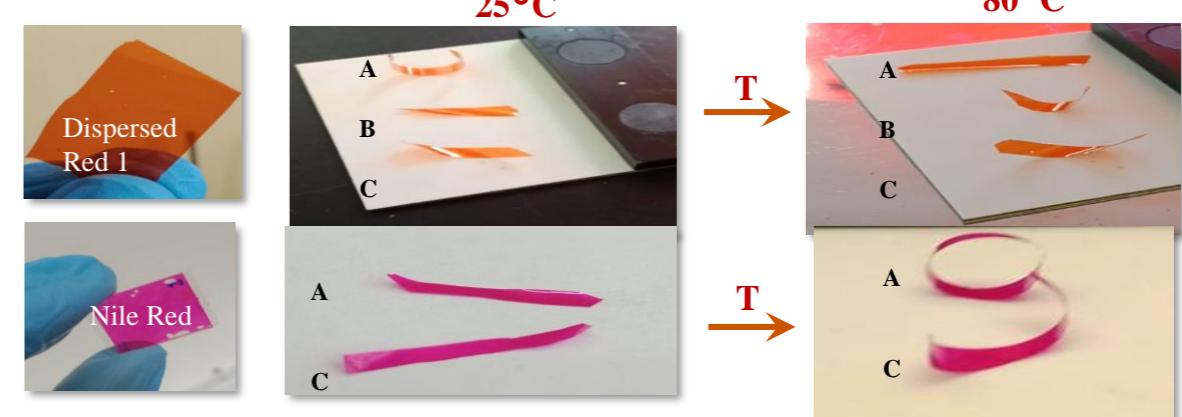
Thermo- & Photomechanical Response

Twisted Nematic

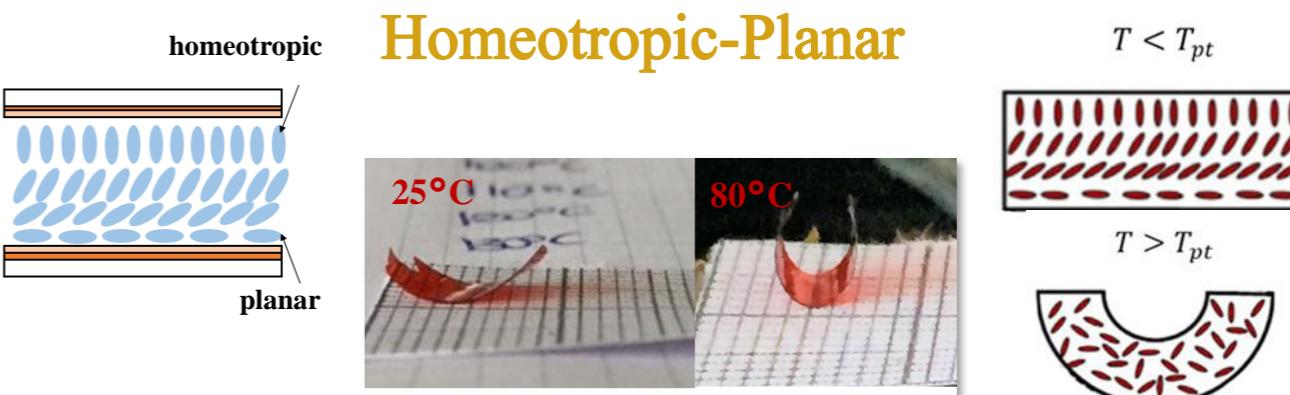
The ILCN the foil was cut into pieces according to the following directions:
A (45°), B (115°), C (90°).



Alignment and cutting direction of the film (top view)



Homeotropic-Planar



On laser irradiation a straight strip bends:

