Preparation of a Mechanochromic Elastomer using Liquid Crystal Dispersed in Polymer

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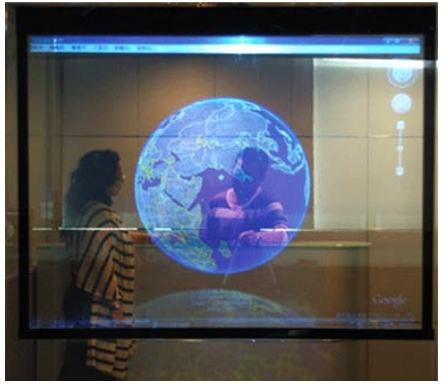
Background | Applications for optically dynamic materials

Conservation

gravinawindows.com

Display



thebwd.com

Sensing

us.hartmann.info

Productivity

thinkgeek.com

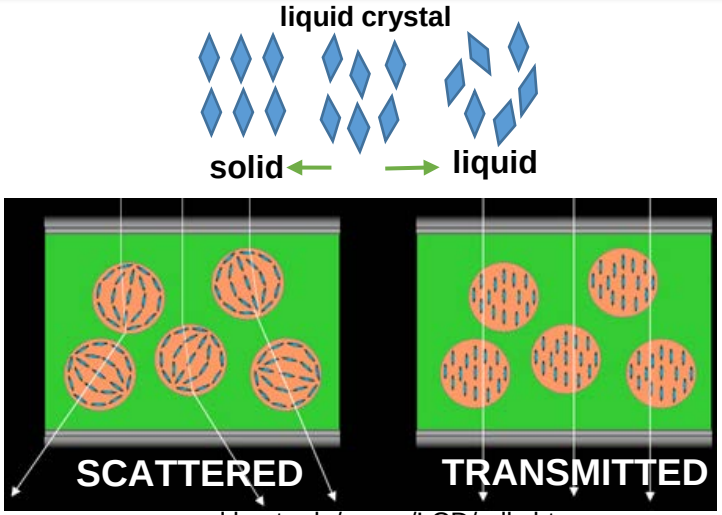
Background | Polymer dispersed liquid crystal (PDLCs)

Mechanism behind PDLC

PDLC materials consist of micron sized nematic liquid crystal droplets dispersed in a polymer matrix. [1]

Reorienting the droplets changes how light is transmitted.

Optical behavior is affected by anchoring energy, size and shape of droplets, and refractive index contrast. [1]

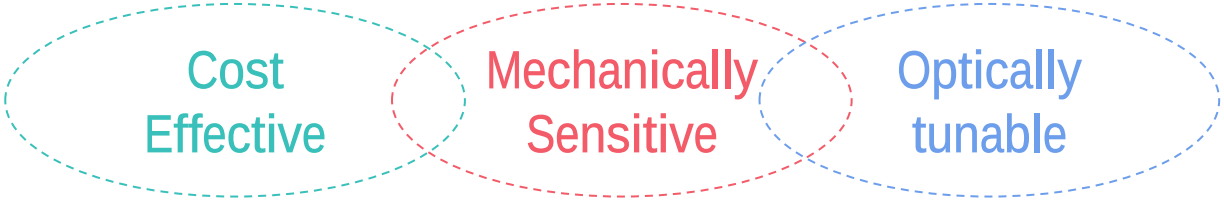


personal.kent.edu/~mgu/LCD/pdlc.htm

Existing PDLC Technology

COMPOSITION	MECHANISM	PERFORMANCE
Liquid crystal concentration ranges from 20 – 99% [2]	Most developed PDLC technology uses electric fields [1]	Total change in transmission varies from 30 – 60% [3]

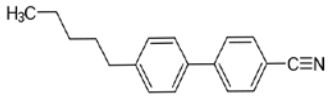
Goal | Design a high-performing mechanochromic PDLC



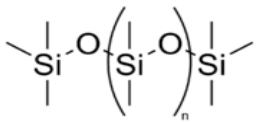
STRATREGY

MATERIALS

5CB liquid crystal



polydimethylsiloxane (PDMS)



EMULSION

Combine PDMS precursor and curing agent in a 30:1 weight ratio

Add 5 weight percent liquid crystal

Stir for 1 minute and degas.

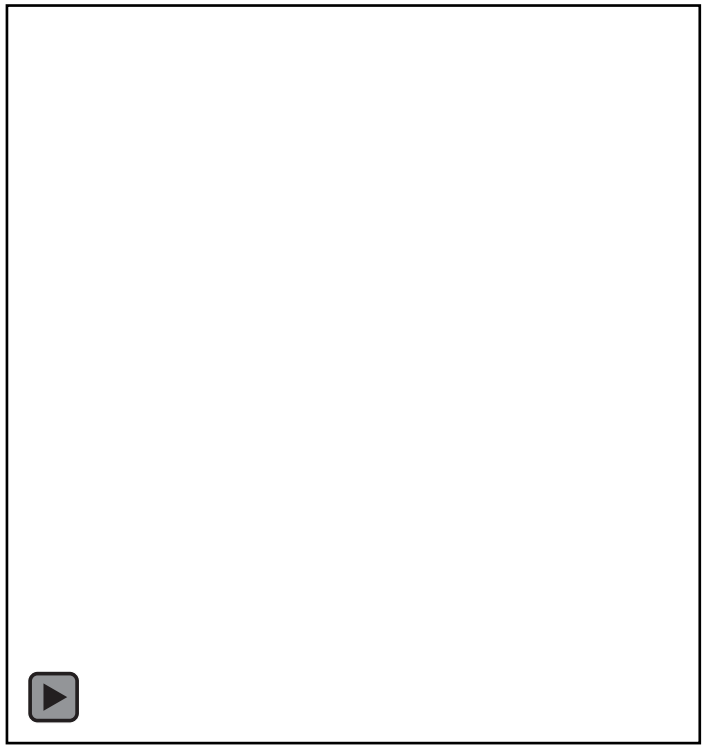
CURE

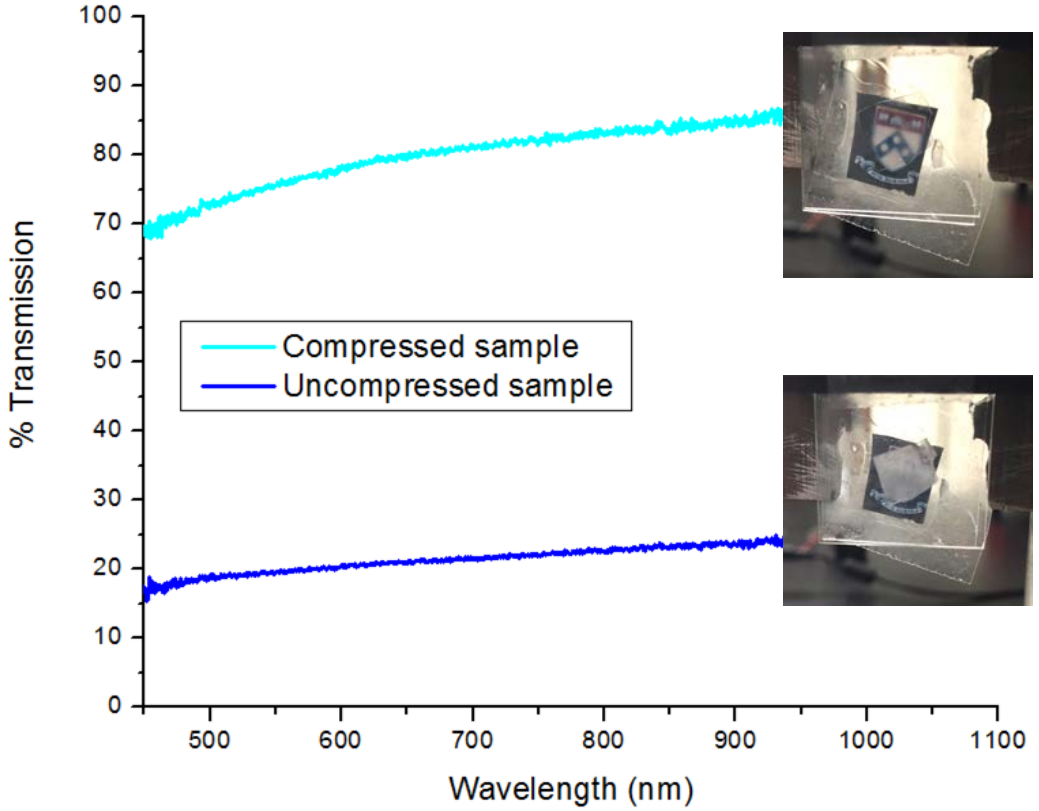
Cast on glass substrate.

Cure at 120°C for 20 minutes.

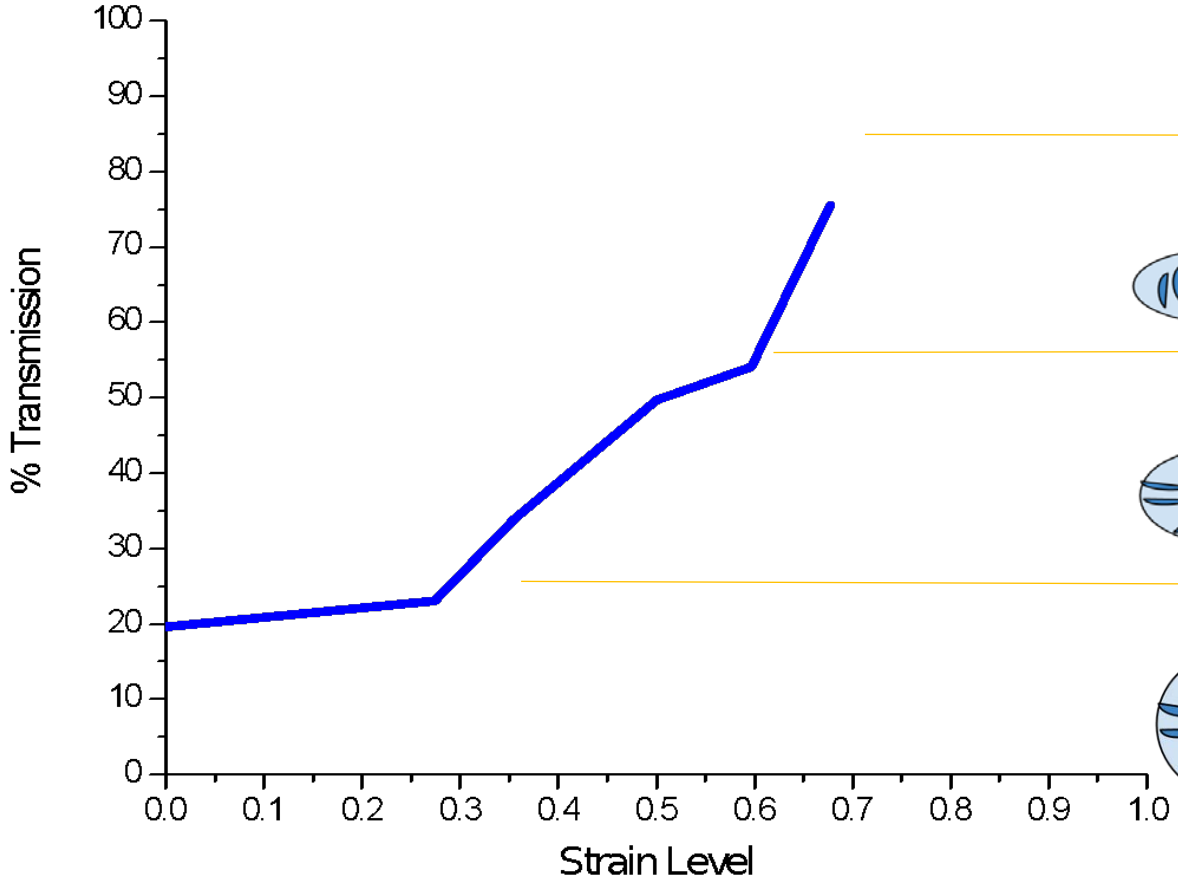
Peel off!

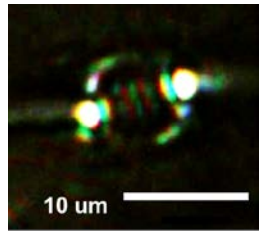
Results | Film exhibits a 50% change in transmittance



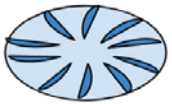


Results | Demonstrates potential for high precision tuning

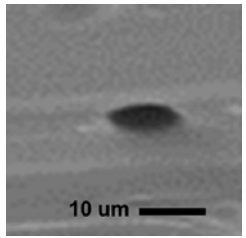


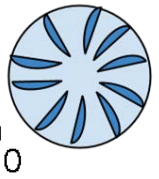


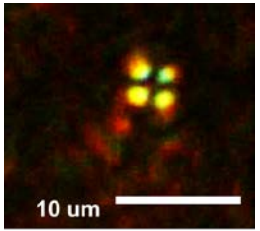
High strain levels change liquid crystal fluctuations



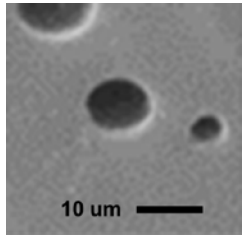
Low strain levels compress polymer void







Optical Imaging



SEM Imaging

Visit my poster to learn:

1. How the optical, mechanical, and morphological properties of this material were characterized.

2. Our plans to use this material for smart windows and biomedical sensors.

Thank you for your time and attention!

References

[1] Korner, W., H. Scheller, A. Beck, and J. Fricke. "PDLC Films for Control of Light Transmission." *Journal of Physics D: Applied Physics J. Phys. D: Appl. Phys.* 27.10 (1994): 2145-151. Web.

[2] Cairns, Darran R., Guy M. Genin, Amy J. Wagoner, Clyde L. Briant, and Gregory P. Crawford. "Amplified Stain-rate Dependence of Deformation in Polymer-dispersed Liquid-crystal Materials." *Applied Physics Letters Appl. Phys. Lett.* 75.13 (1999): 1872. Web.

[3] Gardiner, D.j., S.m. Morris, and H.j. Coles. "High-efficiency Multistable Switchable Glazing Using Smectic A Liquid Crystals." *Solar Energy Materials and Solar Cells* 93.3 (2009): 301-06. Web.

[4] Mucha, M. "Polymer as an Important Component of Blends and Composites with Liquid Crystals." *Progress in Polymer Science* 28.5 (2003): 837-73. Web.