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MECHANOCHROMIC SENSORS BASED ON AQUEOUS SUSPENSIONS OF HYDROXYPROPYL CELLULOSE

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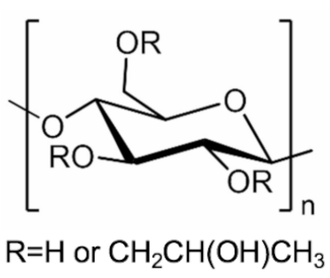
INTRODUCTION

Dynamic color control enables communication and interaction between living species.

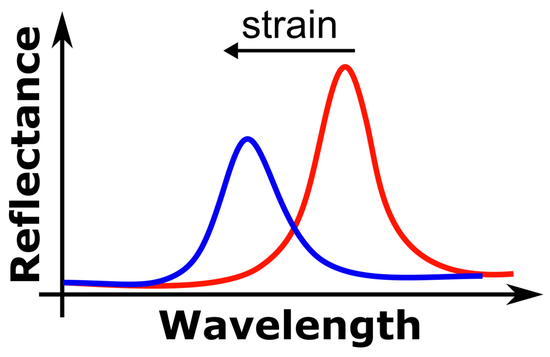
This inspired the development of new color-changing materials. However, most of them are derived from non-renewable sources.

Cellulose, the most abundant biopolymer on Earth, has long been valued as a natural resource, but only in recent decades has its remarkable potential as a photonic material come to light.

Hydroxypropyl cellulose (HPC) is a biodegradable cellulose derivative that self-assembles into chiral nematic phases in water.

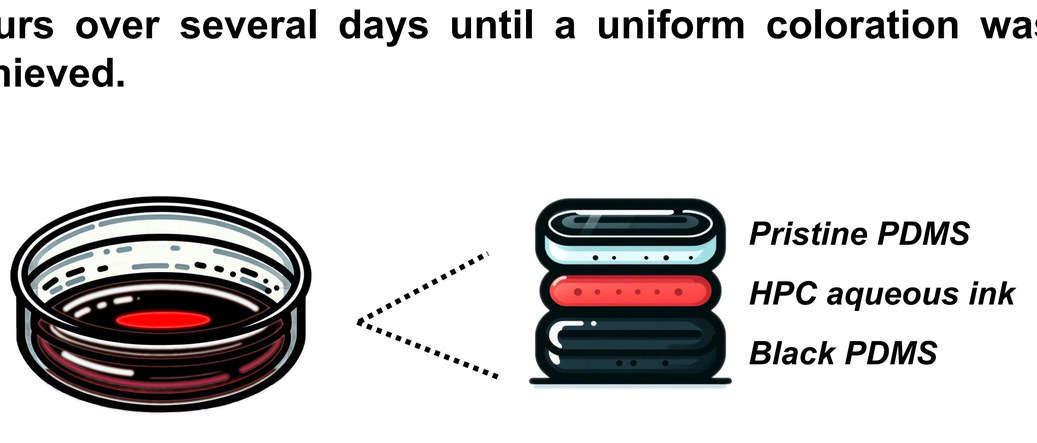


In this work: Strain-responsive photonic sensors based on HPC aqueous mesophases.



MATERIALS AND METHODS

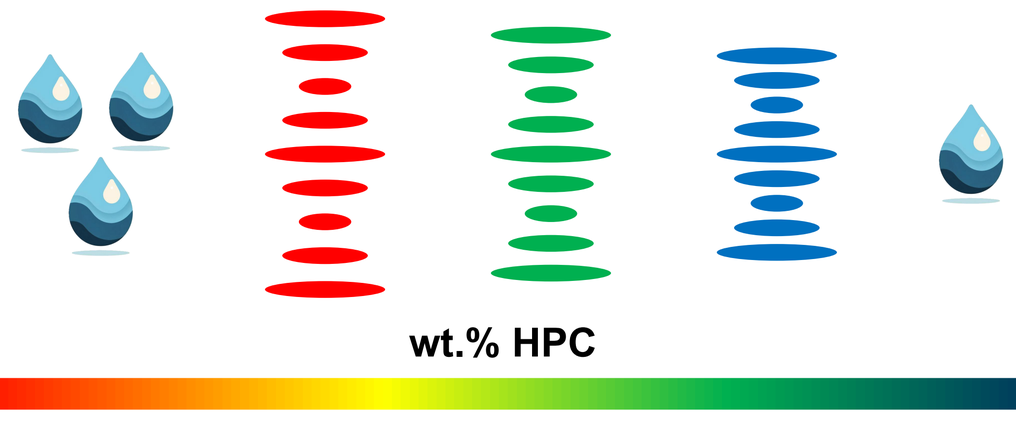
HPC aqueous ink: **HPC powder was mixed with defined amounts of deionized water and homogenized every 24 hours over several days until a uniform coloration was achieved.**



Mechanochromic sensor: **The HPC aqueous ink was encapsulated and sealed between a black and a pristine PDMS layer.**

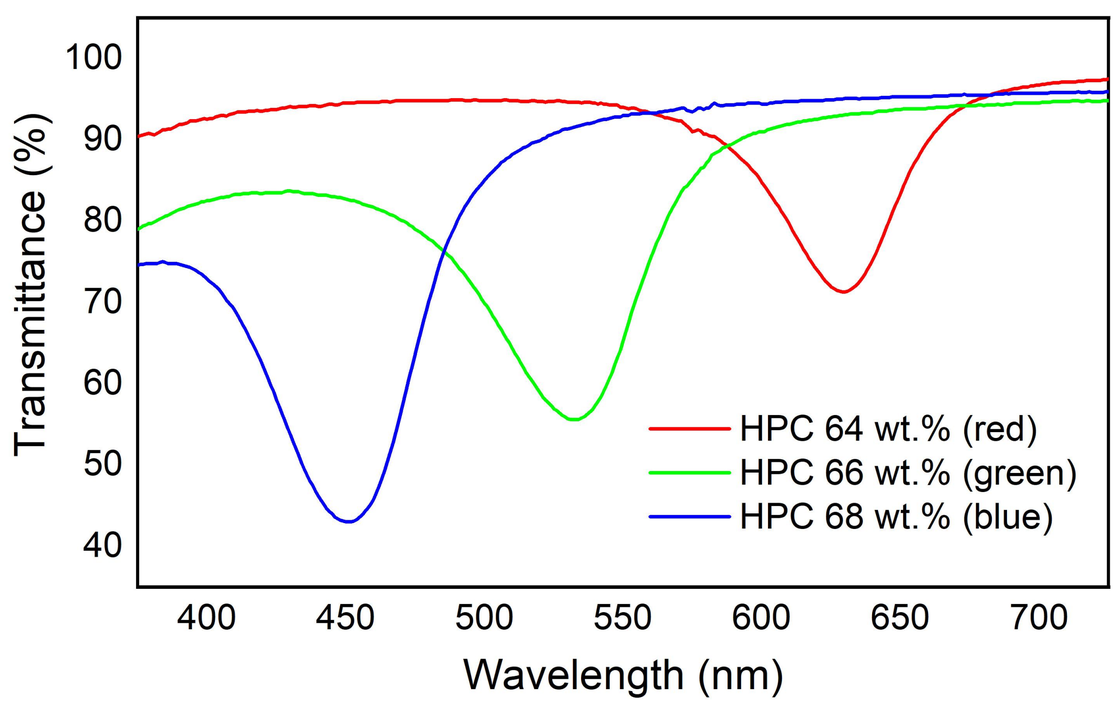
DISCUSSION

HPC self-assembles into chiral nematic phases in water.

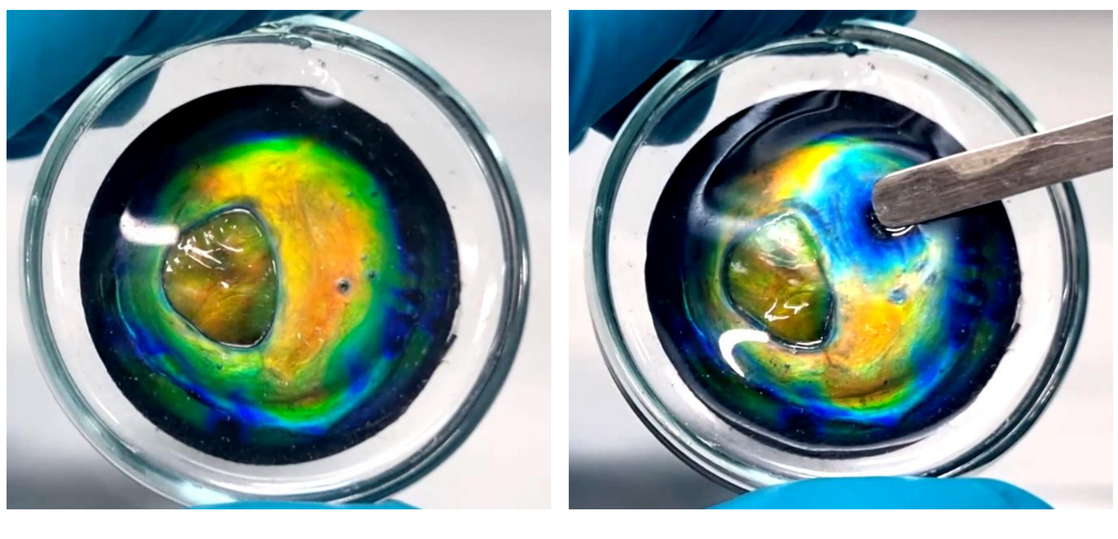


RGB colors were obtained using different amounts of HPC, as evidenced by optical microscope images and UV–vis spectra of the HPC inks.

64 wt.% **66 wt.%** **68 wt.%**



The mechanochromic sensors display striking structural colors that dynamically change under mechanical strain.



The proposed concept offers a scalable platform for strain detection, contributing to the advancement of eco-friendly optical sensing technologies.

REFERENCES

Wei, J.; Aeby, X.; Nyström, G. Printed Structurally Colored Cellulose Sensors and Displays. *Adv Mater Technol* 2023, *8* (1). https://doi.org/10.1002/admt.202200897.

C de Castro, L. D.; Oliveira, O. N. Silica Nanoparticle/Polymer Film-Based Soft Mechanochromic Devices for Detecting Mechanical Deformation and Stress Cycles in Varied Environments. *ACS Appl Nano Mater* 2022, *5* (2), 2906–2911. https://doi.org/10.1021/acsanm.2c00102.

Barty-King, C. H.; Chan, C. L. C.; Parker, R. M.; Bay, M.; Vadrucci, R.; De Volder, M.; Vignolini, S. Mechanochromic, Structurally Colored, and Edible Hydrogels Prepared from Hydroxypropyl Cellulose and Gelatin. *Advanced Materials* 2021, *33* (37). https://doi.org/10.1002/adma.202102112.

de Castro, L. D. C.; Engels, T. A. P.; Oliveira, O. N.; Schenning, A. P. H. J. Sticky Multicolor Mechanochromic Labels. *ACS Appl Mater Interfaces* 2024, *16* (11), 14144–14151. https://doi.org/10.1021/acsami.3c19420.

ACKNOWLEDGEMENTS

This publication is part of the project SusInkCoat with file number P22.006 of the research programme Perspectief which is (partly) financed by the Dutch Research Council (NWO).
The authors acknowledge Nisso Chemical Europe GmbH for kindly providing HPC.