Lignin-Cellulose Liquid Crystalline Systems from Structural Color to Moisture-induced Motion

Francisco Sousa[1], José F. Malta[1], Pedro L. Almeida[1,2], Maria H. Godinho[1] and Ana P. C. Almeida[1,3,*]

[1] *I3N/CENIMAT, Department of Materials Science, NOVA School of Science NOVA University Lisbon (PT)*

[2] *UnIRE/ISEL, Mechanical Engineering Department, ISEL, Polytechnic University of Lisbon, Lisbon (PT)*

[3] *LAQV/Requimte, NOVA School of Science and Technology, NOVA University Lisbon, Lisbon (PT)*

**Corresponding author e-mail: ana.almeida@fct.unl.pt*

Plants have evolved sophisticated strategies to program cellulose-based dead tissues to respond to environmental stimuli such as humidity. A well-known example is the awn of the *Erodium* fruit, which coil and uncoil in response to moisture, enabling seed self-burial [1]. These intricate motions originate from anisotropic cellulose architectures organized in layered structures reminiscent of liquid crystalline elastomers. Similarly, some plant fruits and leaves exhibit structural colours that vary reversibly with hydration. The fruit of *Margaritaria nobilis*, for instance, presents a vivid green-blue hue when fresh that shifts to a pearlescent tone upon drying, a phenomenon arising from helicoidal cellulose arrangements in the pericarp cell walls rather than from pigments[3].

Inspired by these natural systems, our work explores lignin-cellulose liquid crystalline systems as bioinspired materials capable of coupling structural colour and humidity-sensitive motion. Shear-casting of chiral liquid crystalline phases was employed to fabricate crosslinked lignin-cellulose-based membranes exhibiting tuneable coloration and moisture responsiveness. The resulting hydromorphic films were structurally characterized and evaluated under controlled humidity to assess their reversible morpho- and chromotropic behaviors. Our findings highlight the potential of lignin-cellulose composites as multifunctional, sustainable platforms for soft photonic and actuation technologies.

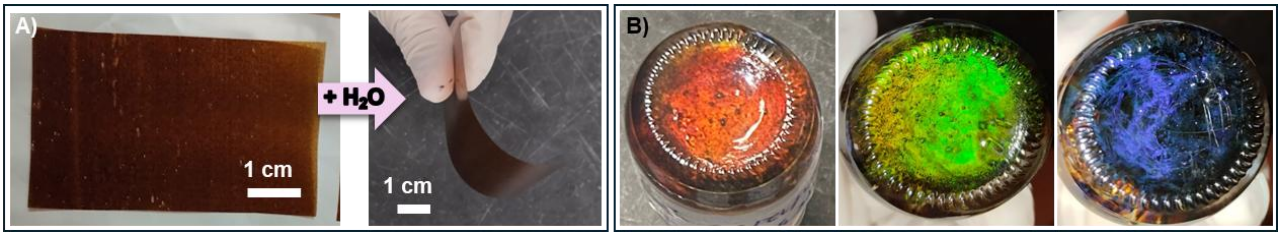

Figure 1. A) Moisture-induced Motion of Lignin-Cellulose film B)Structural colour of Lignin-cellulose composites.

References

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