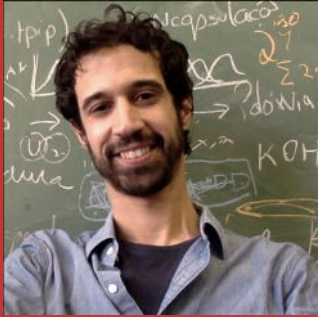




José F. Malta

CENIMAT | i3N - NOVA FCT

BACKGROUND

José F. Malta is graduated in Chemical and Biochemical Engineering at NOVA FCT, and obtained his PhD in Chemistry at University of Coimbra through the ChemMat Materials Chemistry doctoral programme. His work was developed in the Centre for Physics of University of Coimbra and the Centre for Nuclear Sciences and Technologies of Instituto Superior Técnico.

His scientific interests relies in several domains such as structural materials, conductive polymers, thermoelectric materials, magnetic materials, liquid crystals, and band structure calculations of solids. Currently, he is a postdoctoral research fellow at CENIMAT | i3N, within the DynaCellCollect Project, that aims the manufacture and characterization of new hygromorphic cellulose-based meshes to efficiently collect water from air.

Nature inspired cellulose networks for moisture sensing

Abstract

Cellulose-based materials have existed for many years in millennia and contain many advantageous and versatile properties. Plants, for instance, can program cellulose-based dead tissues to respond to external stimuli. One example is the awns of the *Erodium* fruit, which exhibit remarkable coil and uncoil motions in response to humidity. Due to its intrinsic curvature, the straight awns existing in the *Erodium* plants acquire the shape of a right-handed helix after leaving the fruit with the seed. When in contact with water, the awn unwinds, allowing the seed to bury in the soil.

Cellulose-based nature inspired materials have significant potential for opening up new routes for the production of novel mobile soft materials with tremendous impact on intelligent textiles, energy generation, drug delivery, biomedical and biosensing devices, and micro soft robotics. While swollen in water, ribbons isolated from *Erodium* awns are transparent, presenting birefringence between cross-polars. Depending on the moisture quantity, these ribbons change reversible shape from left to right-handed helices. In particular, structures resembling the characteristics of liquid crystalline elastomers are at the genesis of these movements. Thus, these movements result from anisotropic cellulose-based materials organised in layers that contract differently in the presence of humidity.

Inspired by these nature designs, this work focuses on the development of cellulose-based liquid crystalline membranes to be used as hygromorphic sensors and water collecting systems from air. Preparation, characterisation and their potential applications will be presented in this work. In addition, other insights about cellulose membranes for water harvesting and sustainable stimuli-materials with humidity-driven motion and mechanocromic sensing and will be also discussed.



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