Response and Characterization 2: 2:35 - 2:55 p.m.

Stimuli-Responsive Micro and Nano-Helical Fibers Obtained From Cellulose Liquid Crystals

M.H. Godinho[1], J.P. Canejo[1], E.M. Terentjev[2]

[1]*Departamento de Ciência dos Materiais and CENIMAT/I3N, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, P-2829-516 Caparica, Portugal*

[2] Cavendish Laboratory, University of Cambridge, Cambridge CB3 OHE, UK

mhg@fct.unl.pt

Helical nano and microstructures which respond to external stimuli by changes in shape or size present many potential applications in electronically and biologically active materials [1]. Cellulose, along with polypeptides and DNA, belongs to a family of chiral organic molecules that can form cholesteric liquid crystalline (LC) phases, where the direction of preferential molecular alignment rotates in a helical pattern [2]. Recently it was found that helical micro and nano-helices can be obtained from cellulose liquid crystalline phases by the electrospinning technique [3]. The twisting is on a supramolecular scale, and similar to what has been seen in other systems such as amyloid (polypeptide) nanofibrils [4] and cellulose from micrasterias denticulate [5]. By using different electrospinning collectors the fibers can generate aligned membranes. We found that those membranes can alter spontaneously their shape and size as can be seen in figure 1a and 1b. This motion can be induced by temperature. This macroscopic motion seems to be generated by the rotation of the helical structures at the scale of individual fibers as presented in figure 1c and 1d, which results in the increased winding on heating.

The studies that have been performed on these fibers, by using POM, SEM, AFM and mechanical testing, indicate that the mechanism which seems to lead to the curl and twist at the micro nanoscale is due to the non-zero intrinsic curvature of the fibers promoted by the conditions of processing of the liquid crystalline cellulose material. The possible mechanism of this actuation and future applications of these systems will be discussed.

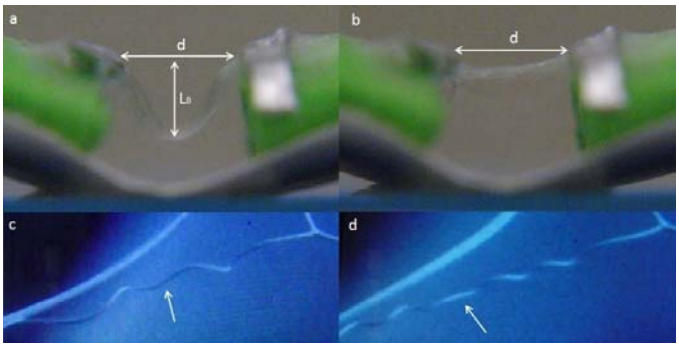

Figure 1 – Cellulose liquid crystalline electrospun materials. (a) and (b) represent the spontaneously changing membrane shape and size modification, (b) was recorded 175 min after (a); d = 4 mm. (c) and (d) Scanning electron microscopy (SEM) images; evolution of a microhelical structure. Electron beam irradiation at the arrow-pointed spot (photo (d) was taken 16 s after photo (c))

Acknowledgments

We would like to thank Fundação para a Ciência e Tecnologia (POCI 2010), project POCTI/CTM/56382/2004 and FLAD for financial support. J.P. Canejo gratefully acknowledges FCT for grant SFRH/BD/37958/2007.

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