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What makes cellulose auxetic?

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The 1D bundles of cellulose microfibrils (lignified flax fiber) and 2D networks of cellulose microfibrils form tunicate, bacterial and microfibrillated celluloses were strained in tension, and their molecular deformation followed by Raman spectroscopy in order to fully understand the origins and magnitudes of in-plane auxetics for the information of innovation. Cellulose is found to exhibit three distinct yielding. Both crystalline and amorphous cellulose are found to be auxetic so long as intermolecular hydrogen bonding remains intact. Auxetics of crystalline cellulose is found to be around unity (-1) while that of cellulose amorphous is found to be around twice (-2) that of crystalline cellulose with the possibility of 1D bundles of cellulose microfibrils registering auxetics higher than -7 in the absence of lignin. Though 2D networks of cellulose microfibrils enhance strain to failure, they also significantly limit auxetics of single 1D cellulose microfibrils in networks. Differences in auxetics between crystals and amorphous must predominantly arise from differences in intermolecular geometry. Similarity of in-plane auxetics of cellulose to the off-axis auxetics of zeolites (especially thomsonite zeolites) indicates the possibility of combining both semi-crystalline materials to produce functionalized composites with photo-electromechanical properties.

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Soy-based bio-nanocomposites: Evaluation of the processing conditions and nanoclay incorporation

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Bio-based plastics are composed by a biopolymer matrix, a plasticizer and some additives to improve the processability or properties of the final product, like nanoclay which is used to increase the water uptake of these biomaterials. For that reason, the overall objective of this work is to clarify the influence of nanoclay content (montmorillonite) in the mechanical and physicochemical properties of bio-nanocomposites obtained from soy protein. These materials were prepared by means of two different processes: an injection moulding process and an extrusion process, using in both cases soy protein (SPI) and natural montmorillonite (MMT-Na^+), being the nanoclay concentration and the processing conditions critical parameters to take into account. Thus, several systems were obtained and evaluated, containing from 0 to 9 wt. % of MMT. Bioplastics' mechanical characterization is performed by dynamic mechanical thermal analysis (DMTA) using a RSA3 rheometer and tensile tests by an electromechanical testing system. X-rays diffraction, confocal laser scanning microscopy (CLSM) and SEM were assessed to analyze the nanoclay incorporation into the material, as well as their structure. Moreover, water uptake capacity is an interesting barrel property which has also been evaluated. An increase in nanoclay content tends to create laminar structure, being this change in structure involved in remarkable changes in mechanical properties as well as in water uptake capacity (the presence of nanoparticles in the protein matrix can improve water uptake).

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