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Área: MAT

Cellulose Films with Distinct Hydrophilicity via Chemical Modification in the DMSO/DBU/CO_2 Solvent System

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Keywords: *Carbon dioxide, Cellulose carbonate, Film casting, Superbase.*

Highlights

The DMSO/DBU/CO_2 solvent system enables the dissolution and modification of cellulose under very mild conditions, specifically when compared to ionic liquids.

Abstract

The depletion of fossil resources has driven academia and industry to seek more sustainable alternatives, particularly in polymer science. Among these, cellulose – the most abundant natural macromolecule on Earth – has gained significant attention. While numerous products and processes have been developed through the physical and chemical modification of solid-state cellulose, its dissolution has emerged as a key area of interest, enabling the production of more homogeneous materials. In 2005, Jessop's group introduced the DMSO/DBU/CO_2 solvent system for organic synthesis. This system consists of a non-ionic liquid (an alcohol and an amine base) that transforms into an ionic liquid (a salt in liquid form) upon exposure to carbon dioxide. Recently, this solvent system has been optimized for cellulose dissolution, producing homogeneous solutions and facilitating chemical modifications under milder conditions. Building on this, this study investigated the incorporation of carbon chains of varying lengths into cellulose (Figure 1), and the regeneration of the modified material in the form of a film. Linear alkyl halides with chains ranging from four to twelve carbon atoms were used as precursors to synthesize cellulose derivatives. Infrared spectroscopy and X-ray diffraction confirmed the success of the reactions, as evidenced by the appearance of the C=O symmetric stretching band of a carbonate ester at 1740 cm^{-1} and the disappearance of cellulose's crystalline pattern. Further structural confirmation and degree of substitution (DS ≈ 0.4) were obtained through ^{1}H and ^{13}C NMR spectra. Additionally, contact angle measurements provided an analysis of the materials' water responsiveness.

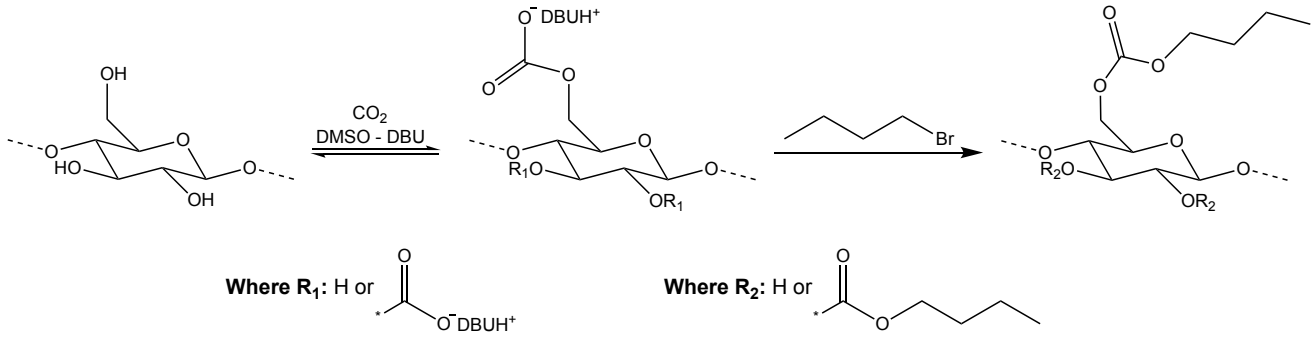

Figure 1. Cellulose solubilization in DBU/DMSO/CO_2 and subsequent alkylation with 1-bromobutane.

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