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PREPARATION AND PROPERTIES OF NANO-CELLULOSE REINFORCED POLYMERS

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An improved route has been established to obtain a higher yield of cellulose microfibrils from MCC and flax fibres, involving a combination of acid hydrolysis and ultrasonic treatment. The high pressure microfluidizer was found to be an efficient method for producing higher aspect ratio cellulose nanofibres with the possibility of scale up for industrial use. To facilitate the ease of homogenization with this process different types of pretreatments have also been explored, including acid hydrolysis, mercerization and silane treatments. Products made by these methods have been characterised by transmission electron microscopy and scanning electron microscopy. Reinforced polyamide-6 films were subsequently prepared in formic acid by combination with negatively charged cellulose nanofibres. These films still remained transparent in the presence of 5% by weight of nanofibres. DSC results show that the presence of the nanofibre promotes the formation of ? crystals, an increase in crystal nucleation rate and overall crystallinity of the PA-6. A significant improvement in mechanical properties, in particular tensile strength, was seen by incorporation of only 5% by weight of nanofibre to the PA-6, but inclusion of this additive reduced the overall thermal stability of the composite. Cellulose nanofibre suspensions were also incorporated into aqueous solutions of polyvinyl alcohol, then cast into film. Addition of 5% by weight of nanofibres doubled the tensile modulus of the polymer and yielded optically transparent films. Dynamical mechanical analysis suggested that a mechanical percolation phenomenon is induced leading to a rigid filler network. In this system there was an increase in the thermal stability in the presence of the cellulose nanofibres although the polymer crystallinity was unaffected. Methods for introducing cellulose nanofibres into melt processed polymers are also discussed, together with their effect on the properties of the resulting composites.