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A mechanistic approach to explain the relation between increased dispersion of surface modified cellulose nanocrystals and final porosity in biodegradable films

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Abstract

Nano-rod reinforced materials for example with cellulose nanocrystals (CNC) has shown great potential. It is common to optimize the compatibility between cellulose, polymer and solvent in order to improve material properties. Here we show that increased compatibility will give more porous films, which from many points of view can be a drawback, e.g. an increased porosity in the material can decrease mechanical and barrier properties. It was hypothesized that the addition of higher amounts of a rod-like nano-filler, i.e. up to 20 wt% to a composite material will cause the nano-rods to overlap, lock the system and introduce pores and cavities to the final material. In order to investigate the hypothesis, nano-composite films consisting of the matrix materials polylactide acid (PLA) or poly(lactide-co-glycolide) (PLGA) and the nano-filler cellulose nanocrystals were produced via solvent casting and the morphology, density and water permeability were studied for the produced films. The addition of both unmodified and modified CNC to the matrix polymers resulted in materials where pores and cavities were present, which was more evident for the modified CNC that was more homogeneous dispersed into the matrix. The presence of pores in the films resulted in decreased density and increased water permeability. The solvent casted films were hot-melt