Nanoprecipitation using modified nonsolvents - functionalized cellulose acetate (CA) nanoparticles

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Cellulose Acetate (CA) is a cheap, stable, widely accepted material with high water permeability. It is used for many industrial products like textiles, filters, plastics, foils, photographic and motion picture films, moldings, coatings, membranes, LCD- displays and controlled drug delivery systems [1]. Compared to bulk material, the small diameters and large surface area to volume ratios of nanoparticles causes changes in the material properties and therefore modified CA nanoparticles were prepared for selective and easy surface functionalization. We present here the first nanoprecipitation technique using organic solvents as nonsolvent modifier. The addition of THF and implementation of sonication plus efficient agitation leads to smaller particles and improved substrate recoveries. Our work includes screening experiments with different nonsolvent modifiers as well as the investigation of system parameters influencing the mean particle diameter like temperature, amount of stabilizer added to the nonsolvent, pH value, stirring velocity and stirrer geometry. Moreover, a targeted functionalization of the nanoparticle surface can be achieved by co-precipitation of CA with (bio)polymers added to the nonsolvent. Our optimized method allows a precise adjustment of the particle size and comprises spherical nanoparticles of 57 nm, 0.19 PdI, with 87 % yield. CA nanoparticle modification with different (bio)polymers comprises negatively and positively charged, functionalized nanoparticles. To the best of our knowledge, we synthesized the smallest CA nanoparticles with highest recoveries ever published. The main theoretical models in discussion give no sufficient explanation for the organic solvent stabilization effects observed [2,3]. Moreover, this is the first time that a controlled functionalization of CA nanoparticles with (bio)polymers is reported.

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