Spherical Nanocomposite Particles Prepared from Mixed Cellulose-Chitosan Solutions

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Novel cellulose-chitosan nanocomposite particles with spherical shape were successfully prepared via mixing of aqueous biopolymer solutions in three different ways. Macroparticles with diameters in the millimeter range were produced by dripping cellulose dissolved in cold LiOH/urea into acidic chitosan solutions, inducing instant co-regeneration of the biopolymers. Two types of microspheres, chemically crosslinked respective non-crosslinked, were prepared by first mixing cellulose and chitosan solutions obtained from freeze thawing in LiOH/KOH/urea. Thereafter epichlorohydrin was applied as crosslinking agent for one of the samples, followed by water-in-oil (W/O) emulsification, heat induced sol-gel transition, solvent exchange, washing and freeze-drying. Characterization by X-ray photoelectron spectroscopy (XPS), total elemental analysis, and Fourier transform infrared spectroscopy (FT-IR) confirmed the prepared particles as being true cellulose-chitosan nanocomposites with different distribution of chitosan from the surface to the core of the particles depending on the preparation method. Field emission scanning electron microscopy (FE-SEM) and laser diffraction was performed to study the morphology and size distribution of the prepared particles. The morphology was found to vary due to different preparation routes, revealing a core-shell structure for macroparticles prepared by dripping, and homogenous nanoporous structure for microspheres. The non-crosslinked microparticles exhibited a somewhat denser structure than the crosslinked ones, which indicated that crosslinking induced a lower degree of freedom during packing of the chains before and under regeneration. From the obtained volume-weighted size distributions it was found that the crosslinked microspheres had the highest median diameter. The results demonstrate that not only the mixing ratio and distribution of the two biopolymers, but also the morphology and nanocomposite particle diameters are tunable by choosing between the different routes of preparation investigated.

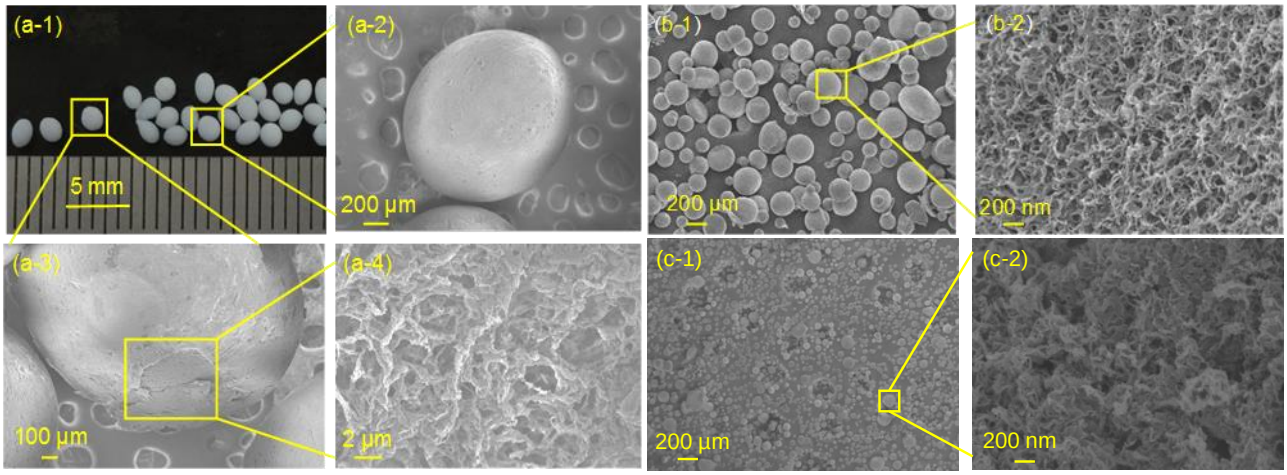

Figure 1. FE-SEM images at different magnification of the biocomposite particles prepared with different routes, (a) macroparticles, CCP; (b) chemically crosslinked microspheres, CCMS-CL and (c) non-crosslinked microspheres, CCMS.

Keywords: cellulose; chitosan; nanocomposite; microspheres; regeneration

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