Cellulose Nanocrystals as a Material for Microencapsulation

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Cellulose is an abundant, biodegradable, and inexpensive renewable polymer that is light in weight with high mechanical strength (Habibi, Lucia, Rojas 2010). Full fibers of cellulose have been used in many products such as plastics and textiles for over a century and a half, but recently, modern extraction techniques have made it possible to investigate uses for minuscule cellulose fibers (Habibi, Lucia, Rojas 2010). Through acid hydrolysis, cellulose fibers become rod-like nanostructures with a high aspect ratio that are known as Cellulose Nanocrystals (CNCs) (Habibi, Lucia, Rojas 2010). Since CNCs are biodegradable and derive from a renewable resource, finding ways to organize CNCs into capsules and particles is a topic of interest, particularly for the medical industry (Gravesen, Branebjerg, Jensen 1993). For this project, CNC particles and capsules were designed and fabricated from single and double emulsion drops generated in microcapillary microfluidic devices. The dispersion of CNC nanofibers in DI-H_2O was also studied to ensure uniformity in the drops. The influence of sonication on the CNC surface charge, and the corresponding rheological properties of the suspensions were studied via rheological and zetapotential measurements. Microcapillary microfluidic devices composed of a coaxial-arrangement of round and square capillaries were fabricated. Double emulsion microdroplets composed of CNC suspensions in the inner and middle fluid were generated to form CNC-loaded hydrogel particles and capsules with diameters ranging from 80 to 150 µm. Finally, the particles and capsules were harvested from solution and their morphology was studied using optical microscopy. These results are the beginning of a robust methodology that will be further developed to fabricate CNC capsules and particles from single and double emulsion drops.