Production of Cellulose Nanocrystals from Recycled Pulp using Enzymatic Hydrolysis and Acid Hydrolysis

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Nanotechnology is present in current technological development due to its physical and chemical properties that allow to improve and create materials. Cellulose can be used as an organic source to obtain cellulose nanocrystals (CNC), which present interesting characteristics for varied applications [1]. The purpose of this work was to study the production and characterization of cellulose nanocrystals by acid and enzymatic hydrolysis using recycled cellulose pulp to verify its viability. In the production of CNC by acid hydrolysis, a mass of cellulose pulp were undergo reaction with H_2SO_4 during 90 min in different concentrations: 7, 8, 9 and 10 $molL^{-1}$, followed by sonication at 20 and 40% of amplitudes during periods of 5 and 10 min. The samples were characterized by optical microscopy (OM), dynamic light scattering, (DLS) and X-ray diffraction (XRD). The results indicated that, the H_2SO_4 solution of 10 mol L^{-1} was very concentrated and caused the degradation of cellulose. After sonication, samples hydrolyzed with H_2SO_4 solution of 7 and 8 $molL^{-1}$ showed higher amounts of crystals as observed by OM. The DLS measures of these suspensions showed that the amplitude was essential to obtain the nanometric dimension. The crystallinity degree of all samples was higher than cellulose pulp as verified by XRD, and this increase was great for short time of sonication (5 min). In the enzymatic hydrolysis, two concentrations of the Celluclast enzyme was used: 42 EGU and 84 EGU (Endoglucanase units per gram), with hydrolysis period of 45 and 60 min, and sonication time of 5 and 10 min at 40% of amplitude. The reduction of cellulose fibers was verified in all conditions tested in enzymatic hydrolysis by OM. DLS values proved that enzymatic hydrolysis is less efficient in the CNC production in the tested conditions, but can be improved and used to obtain CNC. The crystallinity degree of these samples was also higher than cellulose pulp, and the higher values were obtained with in hydrolyses with 84 EGU of enzyme.

[1] N. Durán, A.P. Lemes, A.B. Seabra, Recent Patents on Nanotecnology. **6**, (2012) 16-28.