Electroconductive effect of starch-based films containing multi-walled carbon nanotubes and plasticized by 1-ethyl-3-methylimidazolium acetate

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Recently, the extensive use of petrochemical based plastics for packaging applications has greatly contributed to environmental pollution due to their non-biodegradable nature. Biopolymers from renewable sources are excellent candidates to replace these plastics because of their abundance, low cost and biodegradability. Among them, starch is a promising option because can be degraded without leaving environmentally harmful residues and has been regarded as structural material. Ionic liquids (ILs) that contain a strongly basic, hydrogen bond-accepting anion (*e.g.* small carboxylates or halides), such as 1-ethyl-3-methylimidazolium acetate, can wholly or partially disrupt the intermolecular hydrogen bonding present in starch structure so they can be considered as excellent media for starch plasticization resulting in the development of ionically conductive polymers or solid polymer electrolytes. The IL 1-ethyl-3-methylimidazolium acetate is a good candidate because of its low toxicity, low corrosiveness, low melting point, low viscosity and favorable biodegradability. To improve the mechanical behavior of starch materials, nano-fillers such as multi-walled carbon nanotubes (MWCNT), which have electroconductive features, can be incorporated to the starch matrix. In this work, electroconductive starch-based films were produced by casting technique showing a synergistic effect between the IL and the MWCNT, in terms of the film electrical conductivity displaying excellent values with a maximum higher than 56 S/m and a percolation limit of 0.75 wt.% of MWCNT (0.26 S/m). Films containing 0.5 wt.% of MWCNT displays increments of 327% in maximum tensile strength, 2484% in Young's modulus and 82% in elongation at break, relative to the starch film without nano-filler.