From Polysaccharides to Nanofibrous Membranes: Taking Advantages of Biomaterials Chemistry for Function and Strength of Fibers at Nanoscale

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As naturally-abundant polysaccharides represent potential renewable and sustainable materials in the environmentally-challenging world, their applicable forms require both function and strength. We explore the advantages of biomaterials chemistry at molecular level of the key components in the two biomaterials—chitosan and starch. Firstly, multicarboxylic acids are employed as environment-friendly solvents and in-situ crosslinkers for chitosan/PVA nanofibers with tunable physicochemical properties and biocompatibility (Pangon et al. *Carbohydrate Polymers*, 2016, 138, 156–165). Readily active towards multicarboxylic acids, the chitosan's cationic amino groups offer a platform for ionic interaction and, thus, the physical characteristics are variable upon fine-tuning the degree of crosslinking with biocompatible di-, tri- and tetra-carboxyl crosslinkers. The crosslinking facilitates proliferation and adhesion of the osteoblast cells, providing this mechanically-robust bio-nanofibrous membrane with a potential in tissue engineering. Secondly, rice-flour based nanofibrous membranes for nanofiltration are fabricated by simply allowing immaculate rice flour and PVA to solubilize in alkaline conditions prior to electrospinning (Woranuch et al. *RSC Adv.,* 2017, 7, 19960-19966; Thai patent application number 1701001836). The blend nanofibers show reinforced hydrogen bonding between the two polymers as unveiled by the blue shift of hydroxyl groups. From structure-property study via XRD and thermal analyses, the flour functions as a nucleating agent, promoting crystallization creating more populated nano-sized PVA crystals, which increase tensile strength and Young's modulus. Both studies exemplify the advantages of the bio-nanomaterials' chemistry as a platform for frontier explorations in sustainable materials.

Keywords: Nanofiber, chitosan, multicarboxylic acid, rice flour, hydrogen bonding, nanofiltration, bio-nucleating agent