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PROCEEDINGS

Characterization of Mechanical Properties of CNFs and the Assembled Microfibers Through a Multi-scale Optimization-Based Inversion Method

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ABSTRACT

Cellulose nanofibrils (CNFs) and the continuously assembled microfibers have shown transversely isotropic behavior in many studies. Due to fact that the size of CNFs and the assembled microfibers is at the nano and micro scale, respectively, the characterization of their mechanical properties is extremely challenge. That greatly hinders the accurate multi-scale modeling and design of CNFs-based materials. In our study, we have characterized the elastic constants of both CNFs microfibers and CNFs through a Multi-scale Optimization Inversion technology. Through the tensile test of CNFs microfibers reinforced resin with different volume fractions and the micromechanics model of microfibers reinforced resin, the elastic properties of CNFs microfiber can be backed out via the Particle Swarm Optimization (PSO) method. Next, the mechanical properties of CNFs at the nano scale are derived based on the previously obtained properties of CNFs microfibers and micromechanics model of CNFs fibers via a second-time optimization-based inversion process. These results provide a foundation for an accurate multi-scale modeling and design of CNFs-based materials and structures.

KEYWORDS

Cellulose nanofibrils (CNFs); microfibers; micromechanics; particle swarm optimization (PSO); inversion method

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