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Effects of fiber aspect radio on mechanical performances of nano-short-fiber-reinforced rubber composites

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ABSTRACT

Nano-short-fiber-reinforced rubber composites (NFRC) is a kind of new composites with dual characteristics of nano-composites and short-fiber-reinforced composites. The testing and characterizing methods of the fiber aspect ratio of NFRC was investigated, and the measurements of the fiber aspect ratio were performed. The fiber aspect ratio can be obtained by observation and statistics of the fibers, which are separated from the composite and evaluated by mean aspect ratio method, histogram method, and distribution function method. The dispersity of fiber aspect ratio can be described by the dispersion coefficient. A micromechanical model of single fiber cylindrical cell, which includes fiber, matrix, and their interphase, was established. The influences of fiber aspect radio on the micromechanical stress distributions and mechanical performances of NFRC were studied. The research indicates that the fiber content has little influence on the distribution of fiber aspect ratio. The mean fiber aspect ratio increases with the increase of initial fiber length but decreases with increasing fiber content. The dispersion coefficient of fiber aspect ratio increases with increasing fiber content. Both the axial stress and axial shear stress increase with the increase of fiber aspect ratio. The longitudinal and the transverse tensile modulus increase with the increase of fiber aspect ratio. The longitudinal and transverse tensile strengths increase with the increase of fiber aspect ratio. The enhancement effect on longitudinal mechanical performances is much larger than that on transverse mechanical performance with the increase of fiber aspect ratio.