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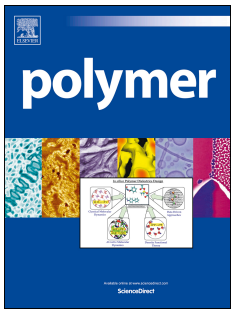

Ductile polyacrylonitrile fibers with high cellulose nanocrystals loading

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Ductile polyacrylonitrile fibers with high cellulose nanocrystals loading

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Abstract

Polyacrylonitrile (PAN) fibers containing up to 40 wt% cellulose nanocrystals (CNCs) were processed. Structure, mechanical, and dynamic mechanical properties of these fibers were systematically investigated. The crystallinity, crystal size and crystallite orientation of PAN in PAN and PAN/CNC fibers significantly increases as the draw ratio increases from 4x to 15x. As compared to the control PAN fiber at a draw ratio of 4x, work of rupture increases by a factor of 2 only for 1 wt% CNC loading, and tensile modulus increased by a factor of two at the same draw ratio in fibers containing 40 wt% CNC. Though PAN/CNC 40 wt% fiber becomes brittle at 4x draw ratio, the elongation at break is significantly improved as fiber was drawn to a draw ratio of 29x and becomes comparable to that for the control PAN fiber at high draw ratio. This is the first study of such a high concentration of nano reinforcement in PAN fibers with good mechanical properties. These results should prove important in reinforcing broader class of polymers with CNCs and other nanomaterials, without making them brittle, which is a common draw back with many reinforcements and fillers.

Key words: Polyacrylonitrile fiber, Cellulose nanocrystals, Ductility