

Chiral nematic self-assembly of minimally surface damaged chitin nanofibrils and its load bearing functions

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Chitin is one of the most abundant biomaterials in nature, with 1010 tons produced annually as hierarchically organized nanofibril fillers to reinforce the exoskeletons of arthropods. This green and cheap biomaterial has attracted great attention due to its potential application to reinforce biomedical materials. Despite that, its practical use is limited since the extraction of chitin nanofibrils requires surface modification involving harsh chemical treatments, leading to difficulties in reproducing their natural prototypal hierarchical structure, i.e. chiral nematic phase. Here, we develop a chemical etching-free approach using calcium ions, called “natural way”, to disintegrate the chitin nanofibrils while keeping the essential moiety for the self-assembly, ultimately resulting in the reproduction of chitin’s natural chiral structure in a polymeric matrix. This chiral chitin nanostructure exceptionally toughens the composite. Our resultant chiral nematic phase of chitin materials can contribute to the understanding and use of the reinforcing strategy in nature.