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Soft composites with the twisted plywood microstructure, a lesson from nature.[1] YONGJIN KIM, ALFRED CROSBY, Univ of Mass - Amherst, CROSBY RESEARCH GROUP TEAM — The twisted plywood microstructure, consisting of rigid structural units within a continuous matrix, is known to be prevalent in many natural materials, including exoskeletons of crustacean, scales of fish, and even bones of mammals. Although it is yet to be resolved whether this structure is a product of evolution or an inevitable consequence of chirality of building blocks, nature utilizes the structure extensively to create various components. Previous studies have focused on fabricating and characterizing synthetic composites with similar structures; however, these composites have been based on a rigid matrix, e.g. an epoxy resin, and hard fibers, e.g. carbon fibers. For this combination of materials, it has been difficult to deconvolute the specific roles of each component. For a better understanding of the advantage of the structure, we have developed flexible composites, comprising a soft matrix and hard fiber bundles at two different size scales. Macroscopic engineered samples were created by combining elastomer and hard fibers, while sub-micron composites are fabricated from self-assembled nanoparticle ribbons and hydrogel matrices. The advantageous mechanical response of these flexible twisted plywood composites is characterized and presented.

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