Composite Fibers

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Bioinspired Green Composite Lotus Fibers**

Mengxi Wu, Hua Shuai, Qunfeng Cheng, and Lei Jiang*

Abstract: *Owing to the growing global environmental problems, demands for environmentally friendly, fully biodegradable sustainable composites have substantially increased across various industries. Inspired by the composite structure of cocoon silk, we fabricated a fully green composite fiber (GCF) that is based on the lotus fiber (LF) and a biodegradable polymer, namely poly(vinyl alcohol) (PVA). After the formation of cross-linkages between the LF and PVA, the mechanical properties of this bioinspired GCF had substantially improved. In particular, the specific mechanical properties are superior to those of cocoon silk and other natural fibers. These findings suggest that LFs may be used as reinforcement materials for the fabrication of bulk green materials for various industries, such as the textile, medical, automobile, and aerospace industries.*

[*] Dr. M. X. Wu,[+] H. Shuai,[+] Prof. Q. F. Cheng, Prof. L. Jiang
Key Laboratory of Bio-inspired Smart Interfacial Science and Technology of Ministry of Education
Beijing Key Laboratory of Bio-inspired Energy Materials and Devices
School of Chemistry and Environment, BeiHang University
Beijing 100191 (P.R. China)
E-mail: cheng@buaa.edu.cn

[+] These authors contributed equally to this work.

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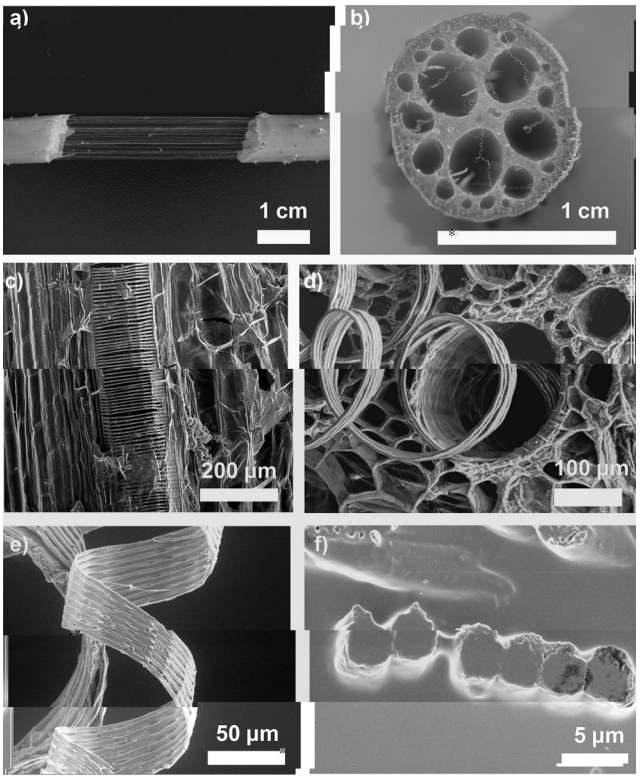

Figure 1. Morphology of natural lotus fibers. a) Digital image of lotus fibers drawn out from the stem. b) Spiral structure of lotus fibers that were assembled in the vessels and tracheids of a lotus stem. c) The SEM image reveals that the lotus fibers are orderly assembled in the vessels and tracheids in the shape of a helix. d) The lotus fibers can be spun out with a left-handed spiral structure. e) SEM image of one spiral lotus fiber bundle with conglutination of several lotus fibers. f) SEM image of the cross-section of one lotus fiber bundle.

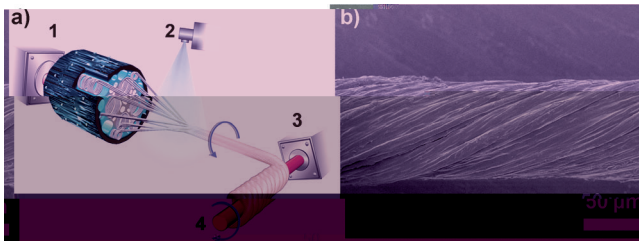

Figure 2. a) Setup for the fabrication of the bioinspired green composite fiber; for details, see the main text. b) A SEM image of GCF reveals a diameter of approximately 80.0 μm.

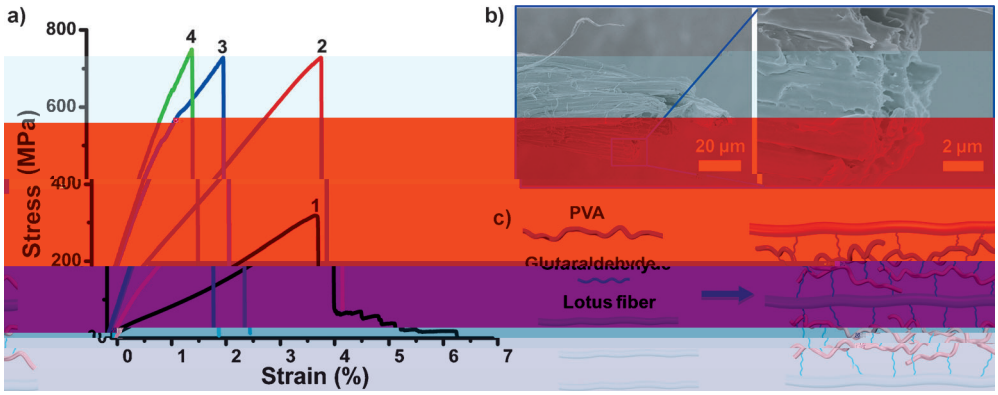

Figure 3. Mechanical properties of pure LF and bioinspired GCF-II before and after cross-linking. a) Stress strain curves of pure LF (——), GCF-II (——), GCF-II with GA cross-linking (——), and GCF-II after both GA cross-linking and heat treatment (——). b) A SEM image of GCF-II after GA cross-linking and heat treatment reveals a typical brittle fracture morphology that is due to strong interfacial interactions between LF and PVA. c) Cross-linking of PVA and LF by GA. The formation of covalent acetal bridges between LF bundles and PVA substantially enhanced the interfacial strength.[22]

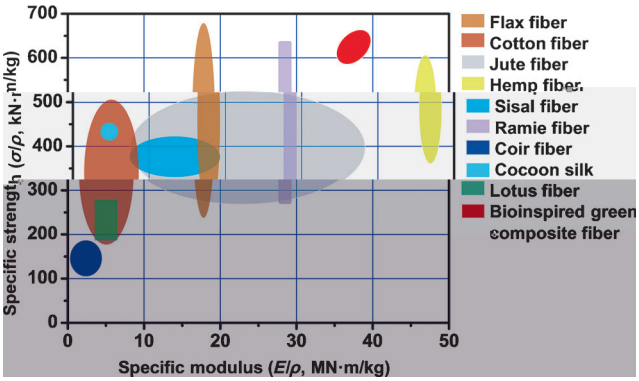

Figure 4. Comparison of specific mechanical properties of the bioinspired green composite fiber with those of commercial natural fibers, such as flax, cotton, jute, hemp, sisal, ramie, and coir fibers, and cocoon silk.

Experimental Section

Ke o d : bioinspired chemistry composite fibers lotus fiber mechanical properties polymers

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