ABSTRACT SUBMISSION

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Functional 3D Electrospun Materials

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ABSTRACT (NO MORE THAN 500 WORDS:)

Electrospun nanofibers, as the forefront of advanced fibrous materials, hold extraordinary potential applications ranging from environmental, energy to biology owing to their integrated advantages of fine diameter, extremely high aspect ratio, and ease of scalable synthesis from various materials. Despite their outstanding potential, the major problem associated with electrospun nanofibers is their anisotropic lamellar deposition character, which leads to the bottlenecks in further improving the thickness and porosity of current electrospun nanofibrous materials. Alternatively, three-dimensional nanofibrous aerogels (NFAs) with both high porosity and excellent compressive resilient might open up the possibility of solving the above problem and expand the applications of electrospun nanofibers; however, creating such NFAs has proven extremely difficult. Herein, we demonstrate a novel strategy to create fibrous, isotropically-bonded elastic reconstructed (FIBER) NFAs with a hierarchical cellular structure and superelasticity by combining electrospun nanofibers and the fibrous freeze-shaping technique. Our approach causes the intrinsically lamellar deposited electrospun nanofibers to assemble into elastic bulk aerogels with tunable densities and desirable shapes. The resulting FIBER NFAs exhibited densities of > 0.12 mg cm^{-3}, rapid recovery from deformation, slight plastic deformation with 14.5% after 1000th cyclic compression at a large strain of 60%, efficient energy absorption, and multifunctionality in terms of the combination of sound absorption, warmth retention and oil/water emulsion separation. Furthermore, the corresponding nanofibrous hydrogels with ultrahigh water content (99.8 wt%) were also prepared and exhibited robust elastic-responsive sensitivity. Additionally, the newly developed ceramic nanofibrous aerogels possess low thermal conductivity (~0.025W m^{-1} K^{-1}) and intriguing temperature-invariant superelasticity to 1100^{o}C. The successfully synthesis of such fascinating FIBER NFAs provide a new insight into the design and development of multifunctional NFAs for various applications.

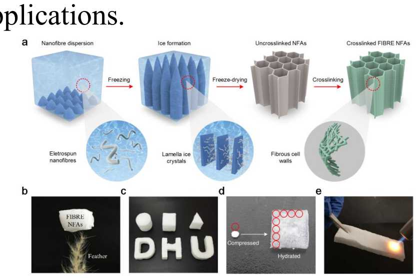

Figure 1. (a) Schematic illustration of the fabrication of FIBRE NFAs. (b) A 20-cm^3 FIBER NFA (ρ = 0.12 mg cm^{-3}) stands on the tip of feathers. (c) FIBRE NFAs with diverse shapes. (d) The water retention capacity of the nanofibrous hydrogels (NFH). A sample of squashed and dried NFH of ~10 mg could hold ~5 g of water. (e) Ceramic nanofibrous aerogels heated by a butane blowtorch without any damage.