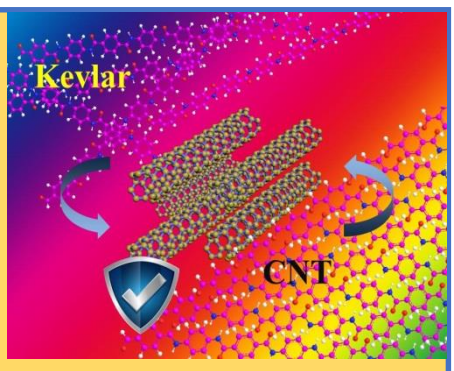
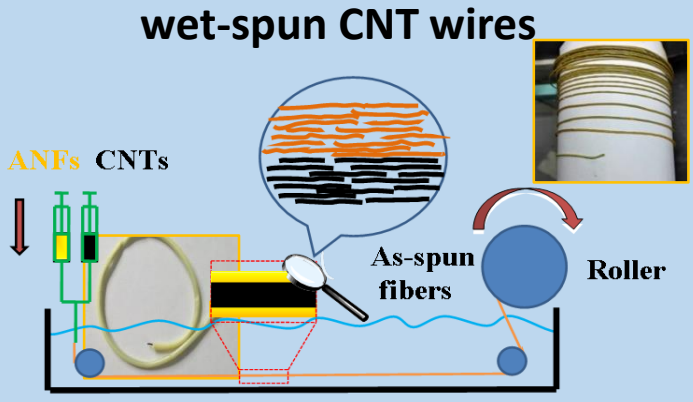
Carbon Nanotube Wires Sheathed by Aramid Nanofibers with Bone-vessel Coaxial Structure

Coaxial fibers with strong sheath and multifunctional core bearing similar geometrical structural to bones-vessel style have attracted so much attention due to their unique one-dimensional inner-outer composition. This poster shows that aramid nanofibers (ANFs) with exceptional environmental stability and mechanical properties can be advanced encapsulation materials for both wet- and dry-spun carbon nanotube (CNT) wires ,which provides a new toolset for the design of functional devices with desired properties. The excellent intrinsic characteristics as well as variable ways of structural organizations make ANF based coatings an attractive tool for the design of multifunctional high-performance bionic functional materials.

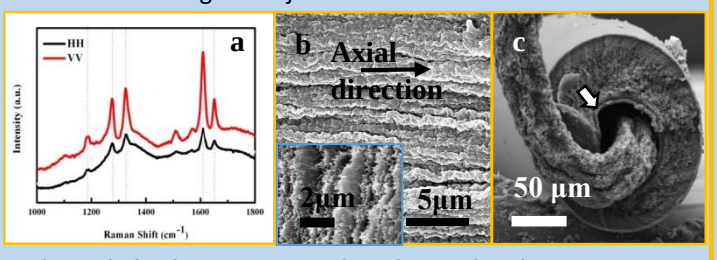


Compact ANF sheath on wet-spun CNT wires



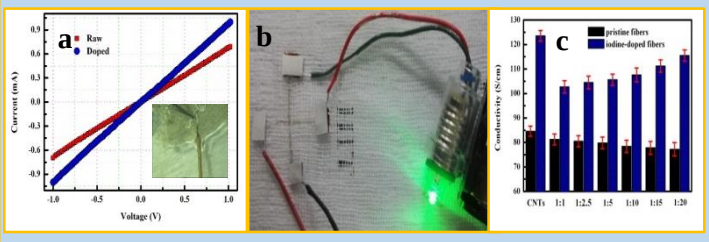
Schematic illustration of the coaxial fiber production

- By co-spun method, both ANFs and CNTs drops are injected and solidification forming continuous bones-vessel style fibers with designed adjustable coaxial structure.

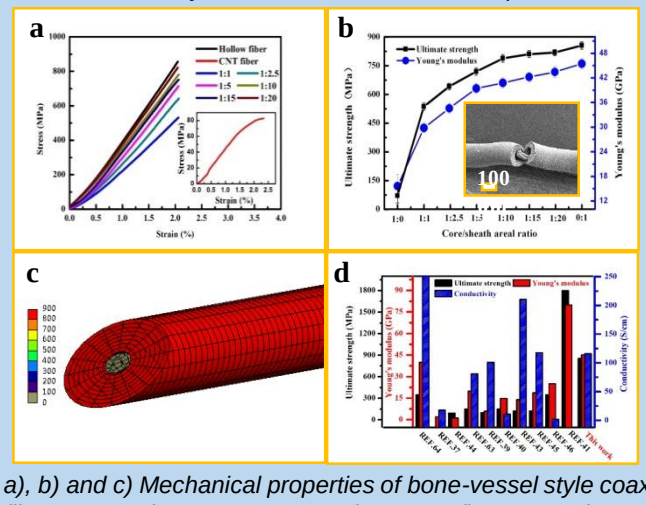


a) Polarized Raman scattering of ANF sheath
b) and c) morphology of bone-vessel style fiber

- ANF sheath with the inset showing the preferred alignment of ANFs along the axial direction, which is analogy as the protection of strong bone to inner vessels.



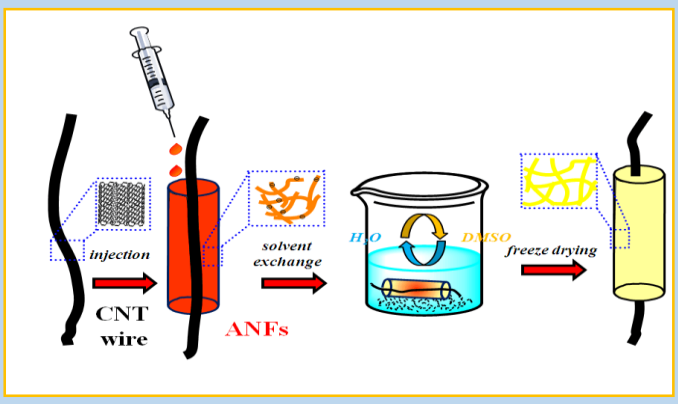
a) Current-voltage curve of coaxial fibers. b) An optical image of coaxial fibers interweaved in the cloth as electrical. c) The maximal conductivity of coaxial fibers can reach up to 115 S/cm.



a), b) and c) Mechanical properties of bone-vessel style coaxial fiber can reach to 855.7MPa and 45GPa. d) A comparison of mechanical properties and conductivity with literature data

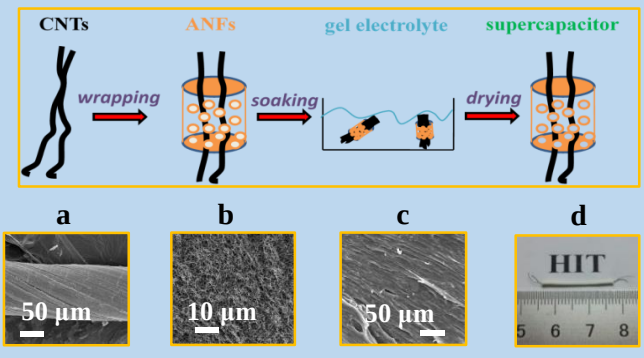
- As the stress protection of born to secure to flow of vessel stability, the impact ANFs sheath undertake majority of force during stretching (96%) and improved mechanical characteristic of whole fiber tremendously (900%), which indirectly enables the protection of core CNT wires without sacrificing the conductivity meanwhile.

Porous ANF sheath on dry-spun CNT wires



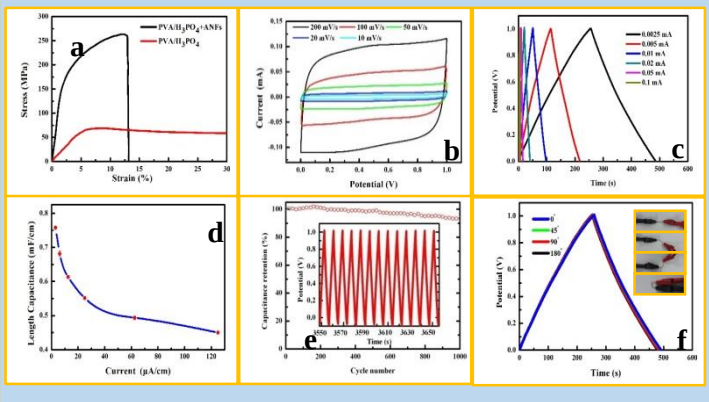
Schematic illustration for the formation of porous ANF sheath on the surface of dry-spun CNT wires

- It's dramatic to notice the randomly distributed ANFs can form rigid colloid during immersion-precipitation process, which peculiarity is similar to the porous of bone for nutrition transmission. Inspired by this idea, ANF is applied to prepare porous sheath coating on vessel-like CNT wires electrode and the electrolyte can transfer smoothly through porous holes.



Schematic illustration for the fabrication of ANF reinforced solid-state supercapacitor.

- Such porous born- vessel geometry is useful for coat porous sheath consisted of randomly distributed on CNT wires, which can be reinforced ionic conductive packaging for solid-state supercapacitors.



a) Mechanical properties of coaxial supercapacitor. b), c), d), and e) electrochemical characteristics of supercapacitor. f) Charge-discharge curve under bending with different angles

- A typical flexible and high energy capacity yarn solid-state supercapacitors is assembled through CNT yarns as electrode incorporation with ionic conductive gel electrolyte and ANF serving as strong encapsulation layer. The supercapactior take both mechanical advance (265.9 Mpa) and good energy storage properties(0.75 mF/cm)

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