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The Solid-State Fabrication, Structure, and Multifunctional Applications of Strong Carbon Nanotube Yarns and Transparent Sheets[1]

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We describe novel methods for producing polymer-free carbon nanotube yarns and transparent sheets (self-assembled textiles), and describe their application as multifunctional materials. These fabrication methods are conducted at room temperature in the solid state for multi-walled carbon nanotubes, which are much cheaper to produce that our previously used single-walled carbon nanotube fibers. The yarns have a maximum failure strength of above 460 MPa (850 MPa after polymer infiltration), they are highly resistant to creep and to knot or abrasion-induced failure, and they provide a giant Poisson's ratio for stretch in the fiber direction. The nanotube textiles have higher gravimetric strength than the strongest steel sheet or the polymers used for ultralight air vehicles and proposed for solar sails. Applications evaluations are described for artificial muscles, thermal and light harvesting, energy storage, field-emission electron sources, electrically conducting appliques, three types of lamps and displays, and sensors.

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