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Super-extendable fibers for transmission line and artificial muscle

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Highly deformable and electrically conductive fibers are needed for diverse applications. Here, we report the supercoil structure (coiling of a coil) inspired, highly elastic, and electrically conducting fibers. The supercoiled fibers were fabricated by inserting giant twist into the carbon nanotube sheath wrapped spandex core fibers. The resulting supercoiled fibers show highly ordered and compact structure along fiber direction and provide structural strain, which enables super-elasticity up to 1000%. The supercoiled fiber exhibited stretch-invariant electrical property that only 4.2% resistance increase is observed for a full stretch when overcoated by passivation layer. Thanks to this performances, the supercoiled fibers can be effective extendable transmission lines that electrical square wave signal (30 Hz) transmitted by the supercoiled fiber showed 92% amplitude retention at fully stretch. The supercoiled fibers also could be electrothermally actuating artificial muscles generating a contracting actuation when electrical voltage applied for Joule heating.

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