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Biscrolling nanotube sheets and functional guests into yarns

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Multifunctional applications of textiles have been limited by the inability to spin important materials into yarns. Generically applicable methods are demonstrated for producing weavable yarns comprising up to 95 wt % of otherwise unspinnable particulate or nanofiber powders that remain highly functional. Scrolled 50 nm thick carbon nanotube sheets confine these powders in the galleries of irregular scroll sacks, whose observed complex structures are related to twist-dependent extension of Archimedean spirals, Fermat spirals, or spiral pairs into scrolls. The strength and electronic connectivity of a small weight fraction of scrolled carbon nanotube sheet enables yarn weaving, sewing, knotting, braiding, and charge collection. This technology is used to make yarns of superconductors, Li-ion battery materials, graphene ribbons, catalytic nanofibers for fuel cells, and TiO_2 for photocatalysis.

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