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Structural engineering of coaxial wet-spun smart fibers for wearable motion sensing

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ABSTRACT
Fiber-shaped flexible sensors have attracted increasing attention for wearable electronics due to their small size, lightweight nature, and excellent compatibility with smart textiles. However, conventional fiber sensors often suffer from limited structural design, unstable sensing performance, and durability issues when applied to complex human motion monitoring. In this work, we present a series of structurally engineered smart fibers fabricated through coaxial wet-spinning, demonstrating how fiber architecture design can significantly enhance sensing performance and multifunctionality. A multi-walled TiO_2/graphene/TPU fiber was designed to achieve a novel pressure-sensing mechanism. Unlike conventional pressure sensors that decrease resistance under compression, this multi-wall structure generates localized microcracks under pressure, resulting in a resistance increase that is particularly suitable for fiber-based sensing systems. The developed fibers show strong potential for applications in wearable motion sensing, gesture recognition, and future intelligent textile systems.