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Graphene-Functionalized Fibres and Textiles for Smart Textiles Applications

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ABSTRACT
Graphene-functionalized fibres and textiles have attracted increasing interest for smart textile applications because they combine electrical conductivity, mechanical flexibility, and compatibility with wearable formats. The purpose of this work is to develop fibre-based graphene materials and textile-integrated structures for wearable sensing, with an emphasis on improving sensitivity, robustness, and environmental adaptability under practical use conditions.
Graphene-functionalized fibres were fabricated and engineered through scalable fibre processing approaches, including wet spinning and related assembly methods, to achieve controlled morphology, conductivity, and mechanical integrity. These fibres were further incorporated into textile-compatible sensing platforms for strain, pressure, and humidity detection. The resulting devices showed high sensitivity and good flexibility, while also maintaining stable performance under repeated deformation. In representative textile sensor systems, the graphene-based fibrous structures demonstrated strong breathability, washability, and resistance to signal interference, enabling reliable operation under complex conditions such as moisture exposure and dynamic motion.
The results show that fibre architecture and material integration play a critical role in determining the sensing behaviour and long-term durability of smart textile devices. Tailored graphene-functionalized fibrous assemblies can simultaneously provide mechanical compliance, conductive pathways, and stable signal output, addressing key limitations of conventional rigid or poorly integrated wearable sensors. It is concluded that graphene-functionalized fibres and textiles provide an effective platform for the development of high-performance smart textiles. By combining nanomaterial functionality with fibre engineering and textile integration, these materials offer significant potential for wearable sensing, intelligent garments, and future self-powered textile systems.