

## Key factors and performance criteria in wearable strain sensors based on polymer nanocomposites

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Recently, there has been a growing demand for wearable electronic devices/strain sensors in soft robotics body-health monitoring, human-machine interface, and human motion detection. Wearable strain sensors feature fast and multi-stimuli sensitivity, high flexibility, ultra-stretchability, and biocompatibility. Although the progress in flexible strain sensors is exponential, the production of wearable sensors undergoes several challenges, such as reliability and reproducibility. The development of flexible and stretchable strain sensors is growing within two streams: (i) engineering microstructure with high functionality to respond to various stimuli such as bending, twisting and tension/compression strains; and (ii) exploring novel materials including functional nanofiller and flexible substrates/matrixes. An in-depth understanding of the sensing mechanism of the flexible strain sensors based-polymeric nanocomposites is needed to fabricate reliable and reproducible sensors and move from the prototype phase into the industry phase. In this review, we discuss types of strain sensors and fabrication methods. Conductive polymers such as polyaniline and polypyrrole and functional fillers, including carbon-based and metal-based nanomaterials to synthesize wearable strain sensors, are systematically compared and discussed. Key parameters such as linearity, gauge factor (sensitivity) and hysteresis are explained in the context of the recently published work. Morphology measurements, structure-property relations and electromechanical properties of the flexible sensors are critically reviewed. Finally, current challenges and perspectives in relation to the wearable strain sensors are concluded.

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