Negative Piezoresistivity-based Smart Fabric Comprising Reduced Graphite Oxide and Capable of Sensing for Stress and Damage

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Abstract

Flexible piezoresistivity-based smart fabric with the ability to sense is valuable for numerous applications and have attracted considerable attention in recent years. Which commonly involve the coating of conventional fabrics with functional materials, the use of multiple types of filament in forming of a yarn, the use of a hybrid fabric and the integration of sensors in the fabric. Their flexibility, durability, functional area, strain sensing range and cost of the sensors are of concern. Piezoresistivity refers to the phenomenon in which the electrical resistivity of a material changes with the strain. Here we report a negative piezoresistivity-based smart fabric distinguishes regular smart fabric from the essential features of the anti-variations of electrical resistivity with the strain. The flexible negative piezoresistivity-based sensing fabrics were fabricated through impregnated treatment of graphene oxide (GO), followed was suffered through the chemical method of reduction in the presence of hydrazine hydrate. The GO was reduced to reduced graphene oxide (RGO) that impacted the fabric electrical conductivity. The electromechanical performance and strain sensing properties of the fabric, which involves the dynamic resistance fluctuation in accordance to the variation of external action pertain to the electrical resistance, displacement and load, were measured simultaneously, continuously and digitally during load increase and the subsequent period of upload by using the four-probe resistence meter and screw-action mechanical testing system. In addition, the composition and structural properties were preformed for the treated fabrics involve the using of the scanning electron microscopy, fourier transform infrared (FTIR) spectroscopy and contact angles. Negative piezoresistivity behavior (relative resistance variation ($\Delta R/R_0$) up to -65% versus cyclic tensile strain of ~10%) has been discovered in our fabric due to multistage composite structure involve the fibers, yarns and fabric weave. The fabric has considerable attributes of hydrophobicity (contact angle nearby 140°). This aussichtsreich smart textile as flexible strain sensors that are enable to monitor the action of body and has more potential applications in flexible electronics.

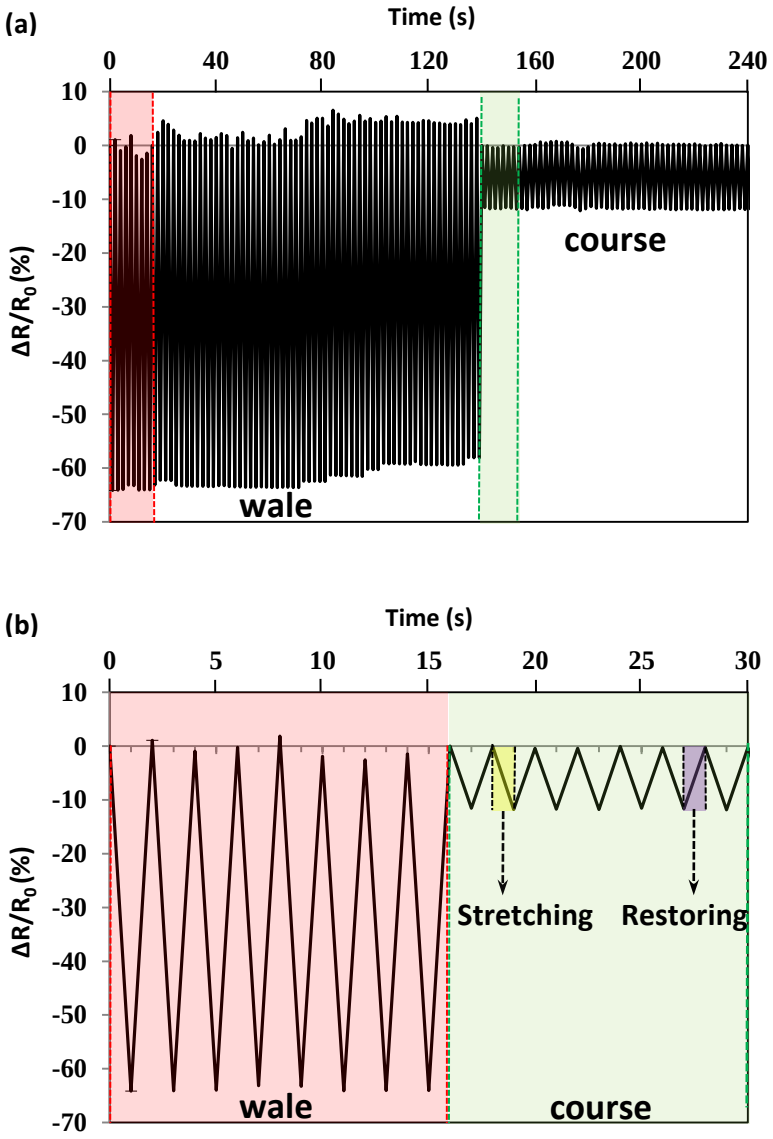

Figure 1: Piezoresistivity behavior of the fabric. (a) Relative resistance variation ($\Delta R/R_0$) versus cyclic tensile strain of 10.7% (durability test for 240 times). (b) Enlarged view of resistance change cycle for wale and course directions, stretching and restoring stage.