Highly Sensitive Graphene Nanoplatelets Strain Sensor for Measuring Impact Loading in Infrastructures

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Abstract: Recently, graphene-based composites have been subjected to extensive research for their potential use as strain sensors to monitor the health of infrastructure [1, 3]. The purpose of this study was to develop strain sensors using nonwoven fabrics coated with graphene nanoplatelets (GNPs). The polyester nonwoven fabric was coated with graphene nanoplatelets using a standard laminator and laminating pouches [2]. An electron microscope (TESCAN MIRA3 FEG-SEM) was used to characterize the morphologies of the graphene coated surfaces. Figure1(a) illustrates the morphology and characterizations of the graphene coated nonwoven fabric. The graphene coated strain sensor was mounted onto a built house stretching equipment using a customized linear step motor controlled by Arduino UNO. Under 3% strain with 0.5 % strain-step, a 2450 Source Measure Unit (SMU) instrument was used to measure the relative resistance changes during stretching-relaxation of the strain sensor, as depicted in Figure1(b). To demonstrate the static response of the strain sensor under a series of loading and unloading tests, a metal weight (150 g) hung and remained stationary onto one end of a plastic ruler holding the strain sensor, the other end of the ruler was fixed. The resistance changes during the loading cycle of the strain sensor were shown in Figure1(c). The results indicated that the trained strain sensor showed excellent sensitivity and stability with average gauge factor of 6.33 under an applied strain of 3%. The prepared strain sensor demonstrated a good static response during loading cycles, which enabled it to be used for the monitoring of infrastructure health.

References

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Figures

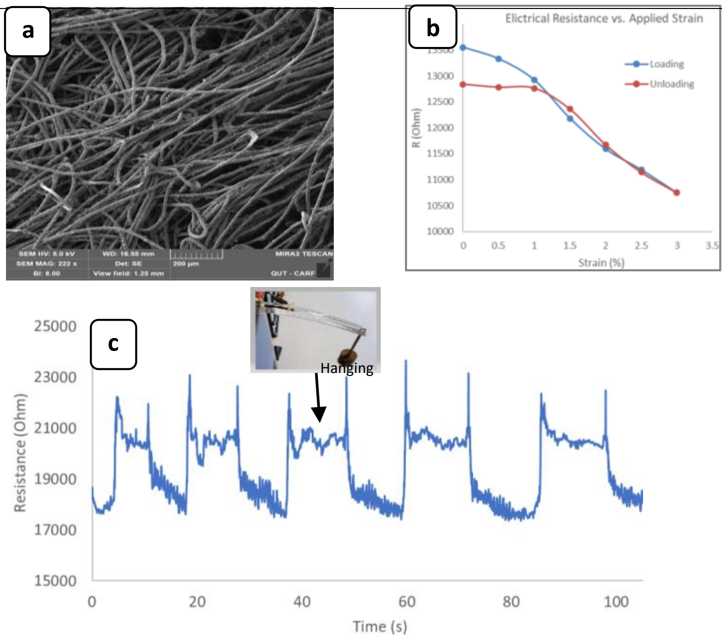

Figure 1: (a) SEM image of the graphene coated nonwoven fabric, **(b)** Electrical Resistance vs. Applied Strain **(c)** the static response of the strain sensor under strain.