Electromechanical properties of piezoresistive polymer materials as a function of the matrix and nanofiller content

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Thermoplastics and thermoplastic elastomers can be combined with different nanocarbon fillers for the development of piezoresistive composites with varying deformation ranges for sensing applications[1]. This work reports on the influence of the polymer matrix on the mechanical and electromechanical properties of polymer composites prepared by solvent casting. Nano carbonaceous filler such as CNT with varying contents up to 5 wt% were dispersed in polymer matrices of different mechanical characteristics, including poly(vinylidene fluoride) (PVDF), styrene-b-(ethylene-co-butylene)-b- styrene (SEBS) and thermoplastic polyurethane (TPU). The electrical properties of the composites are strongly related with the nature of the matrix. Piezoresistive sensibility in 4-point-bending and pressure modes is the largest for PVDF composites with filler concentrations around the percolation threshold: GF≈2.8 and PS≈12 MPa−1, at low deformation bending and pressure tests, respectively.
The different materials have been successfully implemented as pressure sensing materials for human walking detection, allowing to compare the functional performance of the different polymer composite materials[2].

References

[1] J. Teixeira, L. Horta-Romarís, M. J. Abad, P. Costa, and S. Lanceros-Méndez, "Piezoresistive response of extruded polyaniline/(styrene-butadiene-styrene) polymer blends for force and deformation sensors," *Mater. Des.*, vol. 141, pp. 1–8, 2018.

[2] J. R. Dios, C. Garcia-Astrain, S. Gonçalves, P. Costa, and S. Lanceros-Méndez, "Piezoresistive performance of polymer-based materials as a function of the matrix and nanofiller content to walking detection application," *Compos. Sci. Technol.*, vol. 181, no. Mayo 2019, p. 107678, 2019.

Figures

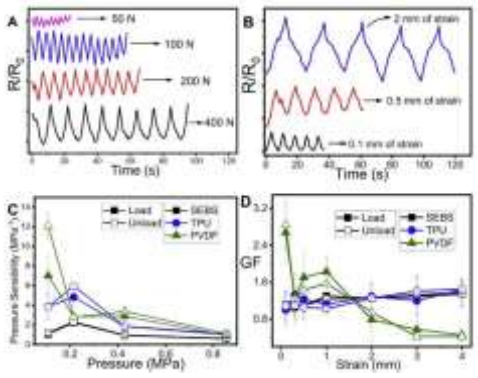

Figure 1: Piezoresistive response of PVDF, TPU and SEBS polymer composites with 5 wt% CNT, measured under uniaxial pressure.

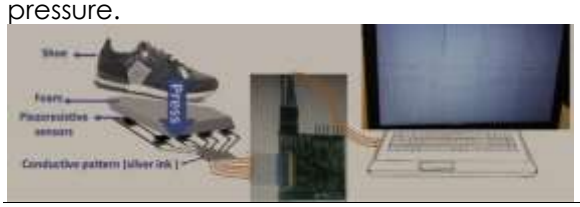

Figure 2: Schematic representation of the developed prototype for walking detection based on piezoresistive surfaces.