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Conductive silicone rubber through carbon nanotubes and its smart application

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Nowadays there is a growing interest in using multi-wall carbon nanotubes (MWCNTs) for development of new materials with unique properties. An example of such new material is MWCNTs-embedded silicone rubber sealing material. Silicone rubber has been widely applied in various industrial fields due to its excellent properties including nontoxicity, biocompatibility, flexibility, low cost, and ease of fabrication. However, some applications require silicone rubber to be conductive, and this conductivity usually comes at a cost. In this research, however, we show that using industrial procedures and 4%wt CNT to make conductive silicone rubber results in a soft (45 Shore A) anti-static (up to 100 Ω-cm) rubber with much preserved mechanical properties. Moreover, the addition of MWCNT to the silicone rubber allows for strain-sensing and radiation damage detecting, demonstrating the benefit of using MWCNT embedded in the matrix as an *in situ* fingerprint for the composite material conditions, and expanding their application under harsh environments. The morphological origins of the superior electrical and mechanical properties, as well as for the *in situ* sensing will also be discussed.

Recent Publications

1. Lachman N, Stein I Y, Ugur A, Lidston D L, Gleason K K, et al. (2017) Synthesis of polymer bead nano-necklaces on aligned carbon nanotube scaffolds. Nanotechnology 28: 24LT01.
2. Wang X, Ugur A, Goktas H, Chen N, Wang M, et al. (2016) Room temperature resistive volatile organic compound sensing materials based on a hybrid structure of vertically aligned carbon nanotubes and conformal oCVD/iCVD polymer coatings. ACS Sensors 1: 37.
3. Natarajan B, Lachman N, Lam T, Jacobs D, Long C, et al. (2015) The evolution of carbon nanotube network structure in unidirectional nanocomposites resolved by quantitative electron tomography. ACS Nano 9:6050.
4. Lachman N, Xu H, Zhou Y, Ghaffari M, Lin M, et al. (2014) Tailoring thickness of conformal conducting polymer decorated aligned carbon nanotube electrodes for energy storage. Advanced Materials Interfaces 1:1400076.
5. Lachman N, Harel Y, Green A, Iuster N, Lellouche J P, et al. (2012) The effect of scale and surface chemistry on the mechanical properties of carbon nanotube-based composites. Journal of Polymer Science part B: Polymer Physics 50:957.

Biography

Noa Lachman is a Member in the Department of Materials Science and Engineering and was previously a Post-doctoral Associate at the Department of Aeronautics and Astronautics at MIT. She received a BS (2003) in Chemistry and Physics from the Hebrew University in Jerusalem, Israel, and completed her PhD work (2010) at the Weizmann Institute of Science, in the Department of Materials and Interfaces. Her research focuses on tailoring and imaging of VA-CNT based composites for various applications, including energy storage and multi-functional structure materials. She uses experimental techniques to obtain knowledge of nano-structure effect on mechanical and functional properties of these new materials, and she aims to develop a structure-function dataset which will enable the design of new materials with improved efficiency and performance. She has authored and co-authored 20 journal articles.

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