Flexible conductive adhesives based on PDMS

Maria C. Paiva
Elsa Oliveira, Duarte Moura, Júlio C. Viana

Institute for Polymers and Composites, University of Minho, Campus de Azurém, 4800-058 Guimarães, Portugal

mcpaiva@dep.uminho.pt

Abstract

The aim of this work is to investigate the formation of flexible and electrically conductive adhesive composites using poly(dimethylsiloxane) (PDMS) and a range of conductive nano and micro particles, [1,2] to investigate the influence of the filler geometry and dispersion on the electrical, dynamic mechanical and thermal properties.
PDMS composites were produced with carbon nanotubes, single-and multi-wall (SWCNT and MWCNT), Indium Tin Oxide (ITO) NPs, mixtures of MWCNT with graphite nanoflakes, and mixtures of MWCNT and Silver (Ag) particles. The composites were prepared on a three-roll mill and the dispersion of the particles in PDMS was observed by optical microscopy and scanning electron microscopy (Figure 1). The combination of particles with different chemistry and morphology for the formation of PDMS composites was studied. Fillers with high aspect demonstrated a positive contribution to the composite electrical conductivity. Conversely, the combination of fillers with different geometry was detrimental to electrical conductivity, except when the fillers had similar chemical composition.
MWCNT/PDMS composites with or without the addition of Graphite flakes presented the higher electrical conductivity results. The storage modulus, E', increased with the filler content and frequency, while maintaining the loss modulus near that of PDMS.
PDMS/MWCNT composites with Graphite nanoflakes showed electrical resistivity as low as 1.5 Ω.cm. The storage modulus, E', increased with filler content while keeping the loss modulus near that of PDMS.
PDMS composites with low concentration of MWCNT and Graphite nanoflakes showed electrical conductivity and excellent mechanical performance, being quite promising for electronic application.

References

[1] S. Simcha, A. Dotan, S. Kenig, H. Dodiuk, Nanomaterials. 2 (2012) 348.
[2] P.C. Ma, M.Y. Liu, H. Zhang, S.Q. Wang, R. Wang, K. Wang, Y.K. Wong, B.Z. Tang, S.H. Hong, K.W. Paik, J.K. Kim, ACS Appl. Mater. Interfaces. 1 (2009) 1090–1096.

Figures

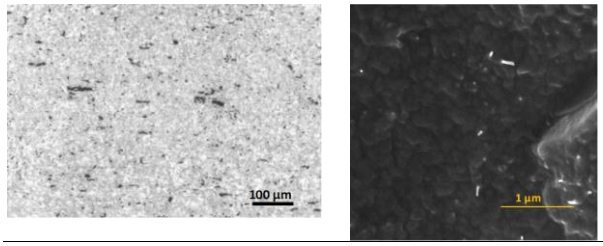

Figure 1: Optical (left) and SEM (right) micrographs of a PDMS composite with 1 wt% MWCNT and 1 wt% graphite nanoflakes.

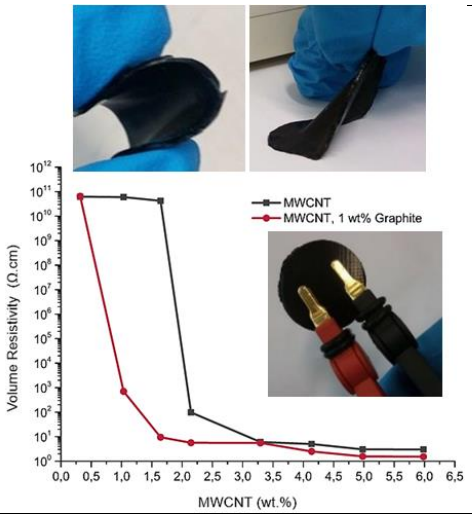

Figure 2: Fotographs of a PDMS/MWCNT/1 wt% Graphite nanoflake composite and percolation curves for PDMS/MWCNT composites and PDMS/MWCNT/1 wt% Graphite nanoflake composites.