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Electrical and vapor sensing behaviors of polycarbonate composites containing hybrid carbon fillers

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Abstract

The vapor sensing behaviors of conductive polymer composites (CPCs) fabricated by dispersing multi-walled carbon nanotubes (MWCNT) and carbon black (CB) in polycarbonate (PC) via melt mixing were studied. Two MWCNT contents of 0.10 and 0.50 wt.% were selected, which were respectively lower and higher than the electrical percolation threshold of PC/MWCNT composites (0.11 wt.%), and different CB contents ranging from 0.5 to 2.5 wt.% were added. The chemo-resistive properties with different hybrid filler contents were investigated by exposing CPC strips to different organic vapors. The vapor sensing response was found to be well correlated to the Flory-Huggins interaction parameter between the solvents and PC. Acetone with the strongest interaction resulted in highest responses, followed by toluene, whereas cyclohexane, as the solvent with the weakest interaction to PC, caused only very low sensing responses. Irrespective of the solvent, the highest relative resistance changes during cyclic sensing were found for the composite with 0.1 wt.% MWCNT and 1.5 wt.% CB, which has the lowest network density. The responses after the first immersion cycle, which can be regarded as equilibration cycle, were the highest for this composite in toluene and cyclohexane. In acetone, the composite with 0.5 wt% MWCNT and 1.5 wt% CB, having the network formed mainly by MWCNTs, showed the highest sensing response.

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