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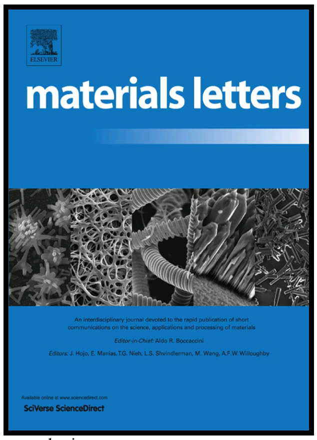

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Particle size induced tunable positive temperature coefficient characteristics in electrically conductive carbon nanotubes/polypropylene composites

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Abstract: A novel approach, *i.e.* manipulating the size of incorporated polymer matrix particles, was proposed to tune the positive temperature coefficient (PTC) characteristics of carbon nanotubes (CNTs) /polypropylene (PP) composites with a segregated microstructure. For the conductive properties of CNTs/PP composites, the percolation threshold decreased from 1.32 vol. % to 0.44% vol. % when the matrix particle size enlarged from 20 to 1200 μm, showing an inverse correlation effect. The controllable PTC characteristics in resistivity are attributed to the microstructure development of conductive pathways and the heat-induced volume expansion of polymer matrix particles. An extremely high PTC material has also been achieved through this method. The present work provides an effective route to acquire a tunable temperature-resistivity sensor.

Key words: Polymeric composites; Electrical properties; Microstructure; Sensors

1. Introduction

Recently, conductive polymer composites (CPCs) fabricated by incorporating conductive fillers (carbon black, carbon nanotubes (CNTs), and metal particles, etc.) into polymer matrices have aroused tremendous attention in both industry and academia fields [1]. Positive temperature coefficient (PTC) effect, as one of the most intriguing physical phenomenon of CPCs, reveals a remarkable increase in electrical resistivity with the increasing of temperature. PTC intensity (I_{PTC}), *i.e.* the ratio of the peak

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