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A. Ameli, Y. Kazemi, S. Wang, C.B. Park, P. Pötschke

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Process-Microstructure-Electrical Conductivity Relationships in Injection-Molded Polypropylene/Carbon Nanotube Nanocomposite Foams

A. Ameli[1,2*], Y. Kazemi[2], S. Wang[2], C.B. Park[2,*] and P. Pötschke[3]

[1]*Advanced Composites Laboratory, School of Mechanical and Materials Engineering, Washington State University Tri-Cities, 2710 Crimson Way, Richland, WA 99354, USA*

[2]*Microcellular Plastics Manufacturing Laboratory, Department of Mechanical and Industrial Engineering, University of Toronto, 5 King's College Road, Toronto, Ontario, Canada M5S 3G8*

[3]*Department of Functional Nanocomposites and Blends, Leibniz Institute of Polymer Research Dresden (IPF Dresden), Hohe Straße 6, D-01069 Dresden, Germany*

** Corresponding authors: a.ameli@wsu.edu and park@mie.utoronto.ca*

Abstract

Foam injection molding experiments were conducted to establish the relationships between process, microstructure and electrical conductivity in polypropylene-multiwalled carbon nanotube nanocomposites. The effects of injection flow rate, gas content, melt temperature, void fraction, and cavity location on the microstructure and conductivity were investigated. At optimum processing conditions, foams with cellular skin and core regions were obtained whose conductivity was 6 orders of magnitude higher than that in their solid counterparts. The conductivity was proportionally increased with the injection flow rate, while it was maximized at optimal values of gas content (0.3%), melt temperature (200°C), and void fraction (30%). Also, a consistently low conductivity was found near the gate location. The conductivity variations were explained in term of the changes that the processing conditions induced to the microstructure and cellular morphology of the skin and core regions. The results of this work find importance in the development of lightweight conductive materials.

Keywords: A. Polymer-matrix composites (PMCs), A. Foams, B. Electrical properties, E. Injection moulding