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MICROWAVE HEATING WITH MULTIFUNCTIONAL GRAPHENE BASED POLYLACTIDE ACID COMPOSITES: EXPERIMENTAL AND NUMERICAL STUDY

Mahima Dua and Pierre Mertiny*
Department of Mechanical Engineering, University of Alberta, Edmonton, Canada
*pmertiny@ualberta.ca

ABSTRACT

Microwave heating may facilitate the joining of thermoplastic polymer components, promising short fusion times, improved heating uniformity, and lower electricity usage, compared to contemporary electrofusion methods with embedded heating wires. This study explores the use of pure graphene nanoplatelets (GNP) and modified GNP (fGNP) to create multifunctional polylactide acid (PLA) composites for high microwave absorption. fGNP was produced by treatment of GNP with tannic acid. GNP/PLA and fGNP/PLA composites were obtained via a two-step scalable fabrication procedure, consisting of solution blending followed by hot compression molding. GNP and fGNP content in the composites ranged from 0 to 8 wt%. Samples were characterized for dielectric permittivity and permeability, heat capacity, and electrical and thermal conductivity. Thermal imaging was used to investigate the efficacy of microwave heating in pGNP/PLA and fGNP/PLA samples as a function of microwave power and filler weight fractions. Multi-physics finite element software was used to explore and explore the microwave heating mechanism in GNP composites. Form this study, microwave heating appears to be a viable option for joining thermoplastic polymer components using multifunctional nanocomposites, with the latter acting as gasket materials for localized heating.

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