

Simultaneous impact modified and chain extended glass fiber reinforced poly(lactic acid) composites: mechanical, thermal, crystallization, and dynamic mechanical performance

John Olabode Akindoyo^{a,b}, Mohammad Dalour Hossen Beg^c, Suriati Ghazali^c, Hans Peter Heim^b, Maik Feldmann^b, Mustapha Mariatti^a

^a School of Materials and Mineral Resources Engineering, Universiti Sains Malaysia, Seberang Perai, Malaysia

^b Institute of Materials Engineering, University of Kassel, Kassel, Germany

^c Faculty of Chemical and Natural Resources Engineering, Universiti Malaysia Pahang, Kuantan, Malaysia

ABSTRACT

Herein, glass fiber (GF) reinforced binary, ternary, and quaternary poly(lactic acid) (PLA) composites were prepared. Toughening, and chain extension of PLA was achieved through the incorporation of impact modifier and chain extender and their concurrent effects on the spectroscopic, crystallization, mechanical, thermal, and thermomechanical properties of the composites were investigated. High mechanical properties of GF influenced the mechanical performance of the composites. However, GF alone could not restrict the chain mobility of PLA due to poor interface and low crystallization activities in the PLA-GF composite. Incorporation of impact modifier and chain extender produced significantly enhanced interaction between GF and PLA. Significantly, the crystallinity, impact strength, and flexural modulus of PLA in the quaternary composite were increased by 58%, 63%, and 66%, respectively. In addition, damping and effectiveness coefficient of the PLA-GF composite were notably reduced by the simultaneous impact modification and chain extension of the reinforced composites.

KEYWORDS

Composites; extrusion; Mechanical properties, Thermal properties; Thermoplastics

ACKNOWLEDGEMENT

The authors appreciate the Hessen State Ministry of Higher Education, Germany for the financial support, and the Institute of Materials Engineering, Universität Kassel for allowing part of the research to be conducted in their laboratory. The first author would also like to thank the Universiti Sains Malaysia for the Postdoctoral Fellowship and the Universiti Malaysia Pahang for their contribution.