

MATERIALS ENGINEERING SEMINAR

“Enhancing Thermal Conduction in Polymer-Based Composites”

By

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Purdue MSE Preliminary Exam

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ABSTRACT

Higher power densities and consumption in electronic devices require heat dissipating components with high thermal conductivity to prevent overheating and improve performance and reliability. Polymers offer advantages of low cost and weight over metallic cases, but their intrinsic thermal conductivity is low. Typical thermally conductive polymers have moderate in plane conductivity, but low cross plane conductivity. Cross plane thermal conductivity is critical to removing heat from active devices and transmitting it to the external environment. In this study, we combine conductive fibers and fillers to enhance thermal conductivity of polymers without inducing significant thermal anisotropy. We employ two approaches to enhance the thermal conductivity (k) of an epoxy polymeric matrix. In the first approach, we fabricate thermally conductive polymer composites by infiltrating Ultra High Molecular Weight Polyethylene (UHMW-PE) chopped fiber mats with an uncured epoxy resin. In the second approach, we create an emulsion consisting of eutectic gallium indium alloy (EGaIn) liquid metal in the uncured polymer. In both cases, the polymer is cured at 70°C. To evaluate the thermal performance of the composites, we use infrared thermal microscopy with two different experimental set ups that allow us to obtain values for the in plane and cross plane thermal conductivity independently. Our future work will focus on assessing the enhancement of k in polymer-based composites (PBCs) by incorporating fibers in combination with liquid metal. Additionally, we will evaluate the mechanical performance of PBCs by varying the matrix stiffness and filler content.

Date: Tuesday, August 8, 2023

Time: 9:30 am

Place: ARMS 1028 or via the link <https://purdue-edu.zoom.us/my/chelseadavis>