Paper ID: 52482
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IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Smart Materials and Adaptive Structures (9)

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TUNABLE POSS-POSS NANOSTRUCTURED MECHANICAL METAMATERIAL FOR ENHANCED DURABILITY OF COMPOSITES

Abstract

In this study, we synthesize a set of "clickable" polyhedral oligomeric silsesquioxane (POSS) molecules to create a nanocomposite with unique metamaterial properties using the highly-selective "thiol-ene" click chemistry. Metamaterials derive unique properties, such as negative dynamic modulus, energy absorption, or highly specific energy absorption, through a structure-property relationship. POSS with its unique hybrid structure, size and several tailorable functional groups allow for the design of highly ordered networks which can be used within composite materials. This is the first study to date that reports on the use of "thiol-ene" click chemistry to design POSS–POSS nanostructures within composite materials. Thiol-ene chemistry is the reaction between a thiol (-SH) group and alkene group, creating a bond between the two. Through a series of chemical reactions, the epoxy ring of Gylcydyl-POSS can be modified to express a thiol group and the commercially available Octavinyl-POSS provides the corresponding alkene group. These two POSS molecules can be mixed with epoxy and hardener, and during the curing process the chemical reaction between thiol and alkene can take place. The chemical modification of the POSS molecule will be characterized using FT-IR and structural effect on the properties of the composite will be determined using compression testing.