Pacific Northwest
NATIONAL LABORATORY

MAaD Science
Materials Aging and Detection Science
@PNNL

10:00 a.m. PT
Wednesday, September 13
Virtual Seminar

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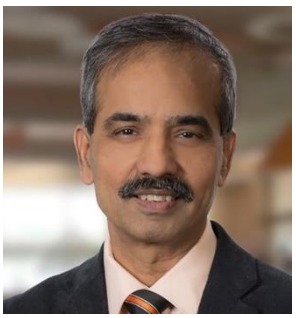
NANOSIZED HYBRID ADDITIVES FOR IMPROVED MECHANICAL, ELECTRICAL, AND THERMAL BEHAVIOR OF CARBON FIBER REINFORCED COMPOSITES

Lightweight carbon fiber-reinforced polymer composites are replacing metallic components due to improved strength-to-weight ratios and fatigue resistance. However, they crack and delaminate due to low-velocity impact which reduces their mechanical properties. Some of the approaches investigated by various researchers include surface modification of carbon fibers and the addition of carbon nanotubes, graphene, or graphene oxide nanoparticles which lead to improved resistance to crack propagation and reducing delamination. However, these methods introduce considerable changes in the standard carbon fiber-reinforced polymers manufacturing process. Hybrid additives (GO+POSS, GO+starch) do not change the manufacturing process or the cure temperature. Graphene oxide (GO) can achieve excellent dispersion with polymer matrices due to functional groups which are compatible with composite matrix systems. Prior research demonstrated successful grafting of GO with polyhedral oligomeric silsesquioxane (POSS) to optimize the thermal stability of GO. Due to the cage-like structure of POSS, dispersion of these hybrid nanoparticles within polymer matrices could result in improved mechanical and thermal properties of composite materials. The effect of hybrid polymer modifiers (HPM), such as Methacryl polyhedral oligomeric silsesquioxanes molecules hybridized to GO (MEGO) was investigated. Results confirmed that the addition of HPM at very low wt.% can enhance the viscoelastic, mechanical, and thermal properties of composites. The presence of GO, POSS, and MEGO was found to enhance the interlaminar fracture toughness by ~70% to ~100% at ~0.5% HPM loading without affecting the strength and modulus.



The Materials Aging and Detection (MAaD) Science Seminar Series at Pacific Northwest National Laboratory presents Dr. Ranji Vaidyanathan at 10:00 a.m. PT on Wednesday, September 13, via Teams. The seminar is free and open to the public. Dr. Ranji Vaidyanathan has several years of entrepreneurial and product development in polymer composites, additive manufacturing, as well as expertise in the areas of recycling and sustainability. He is focused on assisting student entrepreneurship and venture creation at Oklahoma State University. At OSU, he also works with several Oklahoma small businesses and student start-ups. He has 23 patents and is a Fellow of the National Academy of Inventors and a Fellow of the Society for Advanced Manufacturing and Process Engineering. Currently, he is working with his 10th student start-up company, mentoring and assisting them with technical as well as strategic issues in taking their products to the market. A previous student start-up, MITO Material Solutions, has successfully scaled up the hybrid nano-additive, winning more than $1.1 million from the National Science Foundation Small Business Innovation Research program and additional investment worth $7.8 million. Prior to OSU, he was at Advanced Ceramics Research, where he developed an R&D 100 award winning water-soluble tooling material for complex-shaped composite parts.

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