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BNC Distinguished Lecture

The Future of Aerospace Materials: Challenges, Opportunities, and Example Research at the Air Force Research Laboratory

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Bio: Dr. Richard A. Vaia is the Senior Technologist for Emergent Material Systems in the Air Force Research Laboratory (AFRL). His goal is to accelerate research and development at the convergence of Biotechnology, Nanotechnology, Quantum Science, and Infomatics to deliver critical component technologies to address National Defense Strategy, including warfighter-machine teaming, resilient sensing and communication, and futuristic warfighting concepts. Rich has published more than 250 articles on nanomaterials, with honors including the AF McLucas Award for Basic Research, ACS Doolittle Award, Air Force Outstanding Scientist, Air Force Office of Scientific Research Star Teams, DARPA Service Chief Fellow, and Fellow of the Materials Research Society, American Physical Society, American Chemical Society, NextFlex, and the Air Force Research Laboratory.

Abstract: Over a hundred years ago, the pioneers of aviation took flight in no small part due to material innovations ranging from novel casting of aluminum engine blocks to judicious selection of natural materials. Unquestionably, the future of aerospace will look as different from today as the Wright Flyer and Curtiss June Bug differ from UAVs and F35s. However, the role of materials will remain unchanged – they will be the crucial ingredient that enables these future machines to push the performance envelope. Using examples from within the Air Force Research Laboratory, the tools necessary to hasten the development of these vital materials will be discussed. These range from embracing technologies of the digital revolution to accelerate materials development, reduce qualification cost, and provide agile manufacturing methods, to harvesting the potential at the intersection of nano-based metamaterials, smart surfaces, nanostructured devices, and biotechnology to enable autonomous systems that can execute complex tasks in evolving environments.

An example of in-house research will be highlighted, which focuses on establishing large-scale production capacity of Nobel Metal and Layered Transition Metal Dichalcogenides Nano-Particles through a fundamental understanding the growth and exfoliation mechanisms. This underlying insight enables the development of continuous fabrication methods that simultaneously increase production concentration, while reducing structural dispersity, impurities, and reagent waste. These general, transferable, and scalable approaches are expanding evaluation of these unique nanomaterial families for numerous bulk polymer technologies, such as thermal/optical coatings, structural nanocomposites, and inks for flexible electronics

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