Laser Nanodiamond Coatings for Property Enhancement of Light-weight Metal Alloys

Speaker: Dr. Rajeev Nair
Assistant Professor, Mechanical Engineering Department, Wichita State University

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Abstract: Nanoparticles are essential building blocks for manufacturing of nano-structured porous and dense coatings, which have unique properties such as ultrahigh hardness, thermal conductivity, strength, and wear resistance. Nanostructured coatings have significant potential applications in wear resistance with enhanced hardness and toughness. Diamond-Like Carbon (DLC) coatings prepared on aluminum 6061 T-91 substrates with the aid of electrostatic spray coating of synthetic nanocrystalline diamond powders followed by direct laser sintering technique show a lot of promise in improving surface conditions on metals, especially light-weight alloys that have poor wear resistance. Characterizing the metal samples with energy dispersive spectroscopy, Raman spectroscopy, X-ray diffraction and scanning electron microscopy, and functional evaluation of DLC coatings using scratch, micro-hardness, fracture toughness and surface roughness tests show its superior property enhancement when compared to the untreated metal. Sample characterization show a strong bond between the substrate and the coated layer with outstanding chemical and tribological properties and offers the possibility to tailor an extreme lightweight, strong and wear-resistant material.

Bio: Dr. Rajeev Nair, is currently an Assistant Professor in the Mechanical Engineering department at Wichita State University (WSU), and he is actively involved in research, teaching, services, and scholarship activities. His research interests are in laser materials processing of metals, ceramics and composites, tribology of nano-coatings, nanotechnology in manufacturing with focus on lasers, mechanics of composite manufacturing processes and study of machine tools and biomedical devices through design and finite element analysis. Dr. Nair has been actively involved in the development of several grant applications for enhancement of industry/undergraduate/ graduate research and education. He is the Director of the Laser Nano/Micro Materials Processing Lab at WSU and over his academic career has received many external grants as a PI and Co-PI, published several journal and conference publications, and presented his research in numerous venues in the US and outside. His teaching interests are undergraduate and graduate courses in laser manufacturing, mechanical systems design, and materials processing areas. He teaches the mechanical engineering senior capstone design course where student groups work on industry-sponsored undergraduate research projects from Wichita and beyond.