

Nature's Tool Box for Convergent Manufacturing: Rising Above Nano Engineering Principles

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Abstract

Over millions of years, about eight million biological species in air, on ground and in water are in continuous combat with extreme environmental conditions. The fittest have survived through continuous evolution by synergistic convergence of designs, materials and processes for mass scale customization. In particular, biological systems in Nature, which are the active interfaces between subjects and the environment, are being evolved to a higher state of intelligent functionalities. These systems became more efficient by using unique convergence of physical and chemical strategies and elements, namely *Nature's Tool Box*, to manufacture sustainable systems. This tool box and processes collectively enable functional systems to deliver extraordinary adhesion, hydrophobicity, multispectral response, energy scavenging, thermal regulation, antibiofouling, and other advanced functions. Industries have been intrigued with such biological convergent strategies in the Nature in order to learn clever but simple architectures and implement those architectures to impart advanced functionalities into manufactured products. This talk delivers a critical analysis of such inspiring biological strategies and their nonbiological product analogs, where manufacturing science and engineering have adopted such advanced functional architectures based on nanoscale science and engineering principles. Talk will also introduce opportunities and breakthroughs for social innovations and entrepreneurship where nanotechnology applications have resulted in positively impacting millions of people.

Bionote

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As a scientist, engineer, educator, entrepreneur, executive and artist Malshe's interdisciplinary work has focused on the manufacturing, materials, data science and system integration. He has more than 220 peer reviewed publications, more than 20 patents where related products are used across broad industrial sectors world wide, he has trained more than 60 post-doctoral/doctoral/master students and more than 1250 undergraduate students. He has worked extensively with high schools for advancement of students' success. Among Malshe's honors are Member of National Academy of Engineering (NAE), Society of Manufacturing's (SME) David Dornfeld Blue Sky Manufacturing Idea award, SME-S.M. Wu Research Implementation Award; three Edison Awards for Inventor and Innovation; Tibbett Award by US Small Business Association sponsored by EPA for successful tech transfer; R&D 100 Award, Oscar of Innovations; Fellowships of the International Academy of Production Engineering (CIRP), the American Society of Materials (ASM), the American Society of Mechanical Engineering (ASME) and the Institute of Physics (IoP), London, England; multiple best paper awards; NanoBusiness Alliances' Lifetime Achievement Award and Selected Most Influential Nanotechnology Leaders award; Special recognition in getting listed and recognized under "Discoveries" on the National Science Foundation (NSF) home page* for a new process, "Electric Pen Lithography (EPL) for sub 20 nm scale machining and deposition using nano electric discharge machining (nanoEDM) (2005) and many more.