IOWA STATE UNIVERSITY
Department of Mechanical Engineering

High-performance nanoengineered composite at the scale of tons: Extreme strength and radiation tolerance of CNT-metal composites

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Abstract

Nanoengineered composites can directly enhance thermodynamic efficiency and reliability of advanced power plants, prolong durability of gas and jet turbine blades, and contribute to stronger and lighter electric vehicles.

A promising key strategy is to introduce stable one-dimensional (1D) nanostructures in metal, which can possess better structural properties than their counterpart 0D nanoparticles and 2D interface. We will demonstrate an intragranular dispersion of 1D carbon nanotubes (CNTs) in Al matrix that fundamentally improves the room-temperature tensile strength, toughness, high-temperature creep strength, and radiation tolerance without sacrificing tensile ductility, electrical conductivity or thermal conductivity. The mechanisms involve several materials properties and behavior of metals, including traditional dislocation strengthening such as Orowan looping and Taylor hardening, as well as conventional composite strengthening. Well-dispersed percolating CNT network can harden the metal similar to the stored forest dislocation, acting as composite filler to directly transmit the load through interfaces.

I will present an overview of 1D nanocomposite research with which I have been associated over the past six years, ranging from scalable synthesis, in-situ TEM observation, toughening, and radiation tolerance. Based on the progress that has been made, I will discuss my vision to establish a material research program for the design and discovery of nanoengineered materials to boost symbiotic system performance with emphasis on energy applications.

Biography

Kang Pyo So is currently a research scientist at Massachusetts Institute of Technology (MIT). He has been working on developing a high-performance nanoengineered metallic composite at a ton scale by incorporating carbon nanotubes (CNTs). His specialty is synthesis, characterize, and manufacture innovative materials for extreme conditions. His current research interests are in the development of castable nanocomposites for harsh environments such as energy materials, additive manufacturing, and system design. He has invented 18 innovated technologies that lead to register 38 patents and published 26 papers.

Dr. So received his Ph.D. from Sungkyunkwan University (SKKU) in Sungkyunkwan Advanced Institute of Nanotechnology (SAINT) in 2012. He was a post-doctoral fellow at the Institute of a new paradigm of energy science convergence in SKKU in 2012-2013. Since then, he has been a post-doctoral fellow/associate at the Department of Nuclear Science & Engineering at MIT in 2013-2019.

This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.

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