Chromatic Mechanical Response in 2-D Layered Transition Metal Dichalcogenide (TMDs) based Nanocomposites

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Abstract

The ability to convert photons of different wavelengths directly into mechanical motion is of significant interest in many energy conversion and reconfigurable technologies. Here, using few layer 2H-MoS2nanosheets, layer by layer process of nanocomposite fabrication, and strain engineering, we demonstrate a reversible and chromatic mechanical response in MoS2-nanocomposites between 405 nm to 808 nm with large stress release. The chromatic mechanical response originates from the d orbitals and is related to the strength of the direct exciton resonance A and B of the few layer 2H-MoS2 affecting optical absorption and subsequent mechanical response of the nanocomposite. Applying uniaxial tensile strains to the semiconducting few-layer 2H-MoS2 crystals in the nanocomposite resulted in spatially varying energy levels inside the nanocomposite that enhanced the broadband optical absorption up to 2.3 eV and subsequent mechanical response. The unique photomechanical response in 2H-MoS2 based nanocomposites is a result of the rich d electron physics not available to nanocomposites based on sp bonded graphene and carbon nanotubes, as well as nanocomposite based on metallic nanoparticles. The reversible strain dependent optical absorption suggest applications in broad range of energy conversion technologies that is not achievable using conventional thin film semiconductors.

Biography

Dr. Panchapakesan is an Associate Professor of Mechanical Engineering at Worcester Polytechnic Institute. He is the director of small systems laboratory. His lab can be reached at ww.baloolab.org. He has published more than 100 journal & conference publications, book chapters and reviews. His interest are in nanocomposites, flexible electronics/optoelectronics and solar cells.