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Micro/Nano Mechanics and Photonics

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Abstract

Nanostructuring of materials, including atomically-thin two-dimensional (2D) materials (e.g. graphene) as well as semiconductor materials, showed promise to create new functionalities. In my talk, I will discuss how nanostructuring of atomically-thin 2D materials based on the fundamental investigation of mechanics and photonics allows for the enhancement of their exceptional material properties and creating new functionalities in mechanical, optical, plasmonic properties. I will introduce a shrink nanomanufacturing approach of large-scale, uniform crumple-nanostructuring of graphene, which enables mechanical stretchability and strain tunability for flexible photodetector devices

I will also discuss laser nanomanufacturing of 3D porous graphene as well as its hybrid nanomaterials integrating metal nanoparticles with polymer thin films and how laser nanomanufacturing of 3D graphene materials with micro/nano porous structures enables new functionalities such as high-performance hydrogen detection. Finally, I will highlight 2D-interlayer approach that enhances strain-resilient electrical performance (‘electrical ductility’) of metal thin-film electrodes under a high degree of multimodal deformation. Atomically thin 2D-interlayers, such as graphene, induce continuous in-plane crack perturbation (vs. unperturbed straight) of metal thin-film electrodes and enable unique electrical characteristics of ‘electrical ductility’, where electrical resistance remains exceptionally low by orders-of-magnitude ($>10^4 \sim 10^5$) beyond a strain where conventional metal electrodes would be completely disconnected.