# Nanomechanics for Deep Elastic Strain Engineering

Yang Lu*[1]

[1]The University of Hong Kong – Hong Kong SAR China

## Abstract

Under strain, the physical properties of semiconductors can undergo significant changes. However, bulk semiconductor crystals are usually rigid and brittle, making it challenging to achieve sufficient strain levels for desired functional characteristics. Our experimental research has shown that, by microfabricating semiconductors (such as silicon and diamond) into micro/nanostructures, they can exhibit extraordinary elastic deformability. To realize such strain-engineered device applications, we further microfabricated single-crystalline diamond microbridge arrays and have mechanically achieved sample-wide uniform, up to _˜10 %, ultralarge elastic strains under uniaxial tensile loading. This ultralarge strain significantly reduced the diamond bandgap by > 2eV or convert diamond from indirect bandgap to direct bandgap semiconductor, demonstrating its promising applications and immense potential in wide bandgap semiconductors and optoelectronic technologies. Moreover, we have extended deep elastic strain engineering to two-dimensional material systems, exploring their future applications in integrated circuits and electronic devices. This includes pioneering the first tensile and shear tests on free-standing monolayer 2D materials, such as graphene, hexagonal boron nitride and Transition Metal Dichalcogenides, as well as their homo- and heterostructures (e.g., twisted bilayer graphene). These studies not only reveal the anomalous nanomechanical properties of 2D materials, but also underscore the potential of elastic strain engineering (up to _˜6%) for tuning 2D electronic and optoelectronic devices.

---

*Speaker

sciencesconf.org:esmc2025:629096