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Soft-Nano-Materials: Extreme Mechanics at Extreme Length Scales XUANHE ZHAO, Duke University — Over decades of intensive research, various technologies have been developed to manufacture large-scale nanomaterials such as nanoparticles, quantum dots, nanowires, carbon nanotubes, biomolecules, nanofilms, and graphene. Meanwhile, extraordinary properties and functionalities of nanomaterials have been demonstrated by harnessing their deformations and instabilities coupled with their small length scales. However, a grand challenge still exists on how to control the deformations and instabilities of large-scale nanomaterials for scaling-up functions and applications that can impact the society. An emerging paradigm that addresses this challenge is by using soft materials such as polymers, gels and biomaterials to assemble large amounts of nanomaterials and regulate their deformations and instabilities in controlled manners. Successful examples range from nanostructured tissues such as bones and cartilages found in nature to polymer composites with nanowire/nanotube/graphene, flexible electronics, nano-generators and nano-batteries. This talk is focused on extreme mechanics of these soft-nano-materials and systems. We will discuss large deformation, instabilities, and fractures of one-dimensional and two dimensional nanomaterials, such as nanowires and graphene, interacting with matrices of soft materials. We will further illustrate extraordinary properties and functions achieved by understanding and exploiting the extreme mechanics of soft-nano-materials and systems.

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