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Mechanical Behavior of Randomly Packed Nanoellipsoid Films
DAEYEON LEE, University of Pennsylvnia, LEI ZHANG, University of Pennsylvania, GANG FENG, Villanova University — We investigate the mechanical behavior of films composed of randomly packed nanoellipsoids with varying aspect ratio using nanoindentation. The packing fraction of nanoellispoids, determined using gravimetric analysis, is found to have excellent agreement with previously reported results based on simulations. Our study shows that the volume fraction of the films rather than the aspect ratio of the particles is the primary factor that determines the modulus and hardness of nanoellipsoid films. We show, however, that the aspect ratio of the nanoellipsoids has a significant impact on the toughness and the failure mechanism of nanoellipsoid films. While short aspect ratio nanoellipsoid films develop shear bands under nanoindentation, films with high aspect ratio nanoellipsoids do not exhibit shear band formation. We will discuss the potential relevance of our results to other types of random packings such as granular materials and bulk metallic glasses.

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