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Mechanics of colloidal nanoparticle arrays JIE YIN, MARKUS RETSCH, EDWIN L. THOMAS, MARY C. BOYCE, Massachusetts Institute of Technology, BOYCE TEAM, THOMAS TEAM — Hollow colloidal nanoparticles have become a focal point of studies for applications in drug delivery and nanostructured materials. The mechanical properties of individual nanoparticle and the collective behavior of colloidal nanoparticle arrays are of great importance. In this paper, the mechanics of colloidal arrays of hollow amorphous silica spherical nanoparticles during microindentation are explored. The study reveals that the consecutive contact process of nanoparticles during indentation results in highly nonlinear indentation load-displacement curves. The contacted nanoparticles successively become flattened and locally bend and buckle to form a localized dimple as the indentor encounters each particle. By using the contact mechanics model of single hollow particle, the indentation load-displacement formula is obtained for indentation on hollow spherical nanoparticle arrays and the Young's modulus of an individual particle is extracted from the measured load-displacement behavior of an array. The reduced Young's modulus is consistent with the measurement of single hollow amorphous silica nanoparticle by using AFM.

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