Abstract Submitted
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Investigation of Nonlinear Elastic Behavior of Two-Dimensional Molybdenum Disulfide[1] RYAN COOPER, Columbia University, CHANGGU LEE, Sung Kyun Kwan University, CHRISTOPHER MARIANETTI, JAMES HONE, JEFFREY KYSAR, Columbia University — The present study investigates the nonlinear elastic properties of a single-layer molybdenum disulfide crystal through experiment, finite element modeling, and density functional theory. Suspended single-layer molybdenum disulfide crystals are suspended over circular holes that were etched on a silicon oxide surface. Crystals are loaded at the center with an atomic force microscope until fracture occurs. The load-displacement curve is used to determine the pretension and linear-elastic response of the crystal. The force at which fracture occurs gives insight into the intrinsic strength and higher order elastic constants of the crystal. These experiments provide a platform to validate first-principles derivation of fifth-order elastic constants for in-plane stiffness using density functional theory. The derived higher order elastic constants are used in a finite element model to predict the breaking strength of two-dimensional molybdenum disulfide. The study bridges the gap between density functional theory and finite element analysis with experimental evidence.

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Ryan Cooper
Columbia University

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