The investigation of fracture of Silicon nanopillars: study of intrinsic and external size effect.

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A material strength depends on its microstructure, which in turn, is controlled by an engineering process. Quantification strongly depends on the characteristic length scale of a particular microstructure. This microstructural, or intrinsic, size governs the mechanical properties and post-elastic material deformation at all sample dimensions, as the classical definition of *ultimate tensile strength* deems it to be an intensive property, therefore its value does not depend on the size of the test specimen. However, in the last years, the vast majority of uniaxial deformation experiments and computations on small-scale structures unambiguously demonstrated that at the micron and sub-micron scales, this definition no longer holds true.

Study focuses on the both the intrinsic (i.e. microstructural, internal size effect) and extrinsic (i.e. sample size, external size effect) dimensions which play a non-trivial role in the mechanical properties and material deformation mechanisms, it is critical to develop an understanding of their interplay and mutual effects on the mechanical properties and material deformation, especially in small-scale structures. To obtain its properties and the influence of scale in this study, nanopillars made from silicon was made and then tested under atomic force microscope in lateral force microscopy (LMF) mode. The nanopillars were sheared using AFM probes and then with knowledge of shear force the mechanical properties were obtained. Nanopillars varied in pillar diameter and grain size. The study is focused on the investigation of mutual dependence fracture strength due to grain size and pillar diameter.