The Impact of Sidewall Roughness on the Macroscopic Strength of Polycrystalline Silicon

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In order to design efficient, reliable microelectromechanical systems (MEMS), one must understand the statistics of failure. For brittle systems, we can better understand strength distributions through flaw distributions. Specifically, we seek to investigate the role of sidewall flaw size, shape, and spacing on the strength of polycrystalline silicon. Although the deleterious effects of sidewall roughness are well accepted and recent studies have illustrated marked improvements through reduced roughness, most studies have focused on the long crack toughness and the macroscopic strength of polycrystalline silicon. Based on results from atomic force microscopy and transmission electron microscopy, we seek to parameterize the sidewall flaw size, shape, and spacing. Idealized, two-dimensional finite element models of MEMS tensile specimens will be employed to determine the sensitivity of flaw parameters. Through these initial, fundamental studies, we hope to better understand the role of defect distributions on the variation in the macroscopic strength of polycrystalline silicon.