

MULTILAYER FRACTURE - ANALYSIS AND IMPLICATIONS

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Crack patterns in multilayers are studied under various stress states. Cracks exhibit a variety of patterns from parallel and well-aligned lines to intriguing networks such as mudcracks. Integration of experimental observations with theory leads to the determination of mechanical properties of multilayers such as interface strength and film fracture toughness that are difficult to estimate by other testing techniques. In addition to serving as a tool for property measurements, crack patterns also turn out to be useful in nanowire fabrication. A bottom-up technique is introduced which is based on controlled cracking of thin SiO₂ coatings on Si substrates, where each crack with its nanoscale opening serves as a mold to be filled with a second material. When the deposition is followed by removal of SiO₂, the filling emerges as an exact replica of the crack network. The next level of complexity, i.e. a high level of control on wire directionality making the method competitive with top-down approaches, is achieved by specifying initiation and termination points of each crack. This leads to a self-assembled crack network with directions and numbers of cracks designed according to device-specific requirements. Current study on the integration of MEMS with self-assembled nanowires will be also discussed.