Applications of Computational Mechanics on Advanced Film-Type Nano/Micro Structures

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Abstract: Over the past half-century, the pivotal concepts and theories of solid mechanics was maturely developed to describe the mechanical responses of meso-scaled structure. From the viewpoint of traditional solid mechanics, the major concerns of developed analytic solutions were to investigate the mechanical responses of bulk-scaled material. However, the abundance of novel nano/micro process and corresponding material structures with unique mechanical behavior revealed that the limitation of traditional solid mechanics. For this reason, this research is mainly devoted to review the application of computational mechanics on nano/micro structures. As a result of this review paper, application of different computational methods is introduced. The concept and fundamental theories of concerned applications, material behavior estimations, interfacial delamination behavior, strain engineering, and multi-level modeling, are depicted in detail. Several widely used computational methods, ACM, MD, and FEA are comprehensively included to mainly estimate the mechanical responses of nano/micro structures. Moreover, a give example on interfacial adhesion estimation also presented in the paper to systematically estimated the related mechanical reliability issue in microelectronic industry. The presented results revealed that the peeled mode fracture is mainly dominant the delamination behavior of layered material system with the high stiffness along the bonding interface. However, the shear mode fracture being dominated as the polymer cover plate with low moduli is taken into account. Also, the occurrence of crack advance is significantly influenced by the interfacial crack length and applied loading. Therefore, this paper could be served as a guideline of several engineering case with the assistance of computational mechanics.

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