Recent Advancements in In-Situ Nanomechanical Testing

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Abstract:

Understanding the mechanical response and properties of materials at multiple length, time scales, and the test conditions are becoming very important to optimize the performance and develop materials with unique properties. Materials science community has been coming out with new materials with outstanding properties and for applications at normal and extreme conditions. For the underlying research effort, recent instrumentation for structure property correlation has played a critical role. In recent two decades, depth sensing nanoindentation emerged as not only a tool to measure hardness and modulus of materials but other important properties such as viscoelasticity , creep resistance, fracture resistance etc.. at depths as shallow as a few nanometers and temperatures as high as 1000^{o}C. The measurement techniques that were believed not possible a decade ago are becoming possible now with much superior resolutions and accuracies. Besides indentation, today's nano- and micromechanical methods include compression, tension bending, fracture, fatigue and creep tests. This talk will demonstrate this capability of structure property correlation from results on the in-situ nanomechanical testing of various engineering materials using Bruker-Hysitron Nanomechanical Test Instruments. The results will be reported and the physical insight regarding the deformation mechanisms will be discussed. The main focus will be on the instrumentation techniques to improve the research efforts, and develop fundamental understanding of deformation mechanisms of materials