Expanding the Use of Frequency Specific Techniques during Nanomechanical Testing

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Since its invention in 1992 (US patent No: US4848141 A) frequency specific indentation testing has become a powerful tool for researchers to characterize materials and structures at small scales. The fact that the stiffness of a contact between two materials is much easier to measure at small contact dimensions became obvious near the first implementation of nanoindentation testing. Models were developed to use these measurements to understand the elastic response of materials soon after the first measurements. The low values of stiffness exhibited by extremely fine scale structures are also often easier to measure accurately than their macroscopic counterparts. In this talk we will review the use of frequency specific mechanical excitation to measure the stiffness of a contact or structure. To accurately perform these experiments over a wide range of the important experimental parameters (frequency, time, temperature, load, displacement and stiffness) the experimental equipment must be carefully designed in such a way that the base line dynamic response is as simple as possible. The accuracy of the model used to describe the apparatus determines the smallest and largest values that can be measured from the sample.

Indentation testing with sharp, pyramid shaped indenters are now done over an extremely wide range of depth, load, and stiffness. They are still one of the most common and challenging type of experiment to perform. The stiffness of the contact changes many orders of magnitude during the indentation process. The newest testing and analysis techniques for these experiments will be discussed. The time required to perform these tests has been reduced several orders of magnitude. The increased speed with which the experiments can be performed has opened the door to new applications for these experiments. These include mapping properties in both two and three physical sample dimensions and high temperature testing.

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