MEASUREMENT OF HARDNESS AND ELASTIC MODULUS BY DEPTH SENSING INDENTATION: IMPROVEMENTS TO THE TECHNIQUE BASED ON CONTINUOUS STIFFNESS MEASUREMENT

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The method to measure hardness and elastic modulus of small volumes of material by instrumented indentation presented in the seminal works of Oliver and Pharr in 1992 and 2004, has revolutionized the field of small scale nanomechanical testing. Several recent advances in measurement electronics have enabled testing over a wider range of test conditions (speeds) using methodologies that were developed earlier, which requires a critical assessment. In the backdrop of the latest developments in instrumentation and test methodologies, an overview of the various factors affecting the precision and accuracy of the nanoindentation test results at different test conditions with specific focus on Continuous Stiffness Measurement (CSM) technique will be presented. The CSM technique has also been used to explore the time dependence of material properties. In particular, the stiffness of the contact together with the modulus of the material being characterized gives a direct way of calculating the contact area at any instant that is relatively insensitive to thermally driven displacement drift rates. One of the parameters used to calculate the hardness being measured in such experiments is the load being exerted on the sample by the indenter. The CSM technique requires that the load on the sample be modulated to some degree at a specific frequency. The question arises what value of the load should be used to calculate the hardness when the load is being modulated. Results indicating how the load could be chosen will be presented.