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A METHODOLOGY FOR THE CALIBRATION OF SPHERICAL INDENTERS

J. Gregory Swadener and George M. Pharr

The University of Tennessee, Dept. of Materials Science & Engr. , Knoxville, TN
and Oak Ridge National Laboratory, Metals and Ceramics Division

Spherical indentation with load and depth sensing is a useful technique for characterizing thin film mechanical properties. With this technique, the initial loading is in the elastic range. Therefore the elastic-plastic transition can be observed. However, the calibration of spherical indenters presents special problems. First, the radius of the indenter at the point of contact must be determined, and any deviation from a spherical radius must be evaluated. The shape of the indenter also causes mounting difficulties that can create a relatively large and nonlinear compliance in the testing machine. The calibration of spherical indenters is further complicated, because asperities on the indenter and surface roughness add to the uncertainty in locating the surface of the sample. In addition, spherical indenters are generally made of anisotropic single crystals, and the calculation of their elastic responses must include their anisotropy. To address these difficulties, a methodology has been developed for the calibration spherical indenters, whereby indentation experiments are conducted on multiple ceramic materials in the elastic range. The method was used to determine the local radius of a synthetic ruby spherical indenter. The accuracy of this measurement was verified using confocal microscopy. Using this indenter, the total machine compliance was approximately twice the compliance of the same machine using a diamond Berkovich indenter. In addition, the nonlinearity of the machine compliance was determined. Further results involving indentation in the plastic regime will also be presented.

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