Effects of Surface Stress State on Nanoindentation Measurements[1]

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The stress state of a ductile material has long been recognized as influencing the measured hardness of the material using conventional techniques. Using hardness measurements to determine residual stresses was proposed nearly 50 years ago. Attempts to quantify the effect of the stress state on properties measured by nanoindentation using sharp indenter tips have shown that the effect was detectable, but not sufficient to determine the stress state.[2] However, a recent finite element study predicts that a spherical indenter should provide greater sensitivity to the stress state.[3] This investigation presents experimental results for spherical indentation that support the predictions of the finite element simulations. The indentation experiments were conducted on an aluminum alloy with the tested surface in biaxial tension. Changes in the surface stress of 10% of the yield stress produced significant measurable differences in the experimental results.

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