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Anisotropic Elastic Moduli from Nanoindentation and Ultrasonic Velocity Measurements in Human Tibial Cortical Bone [1]

J. G. Swadener (*), J. Y. Rho (+), J. Fan (+) and G. M. Pharr (*)

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

(+)University of Memphis, Dept. of Biomedical Engineering, Memphis, TN

Many biological materials are anisotropic. Cortical bone is one of these materials, and it contains microstructures, such as osteon lamellae, which are on the order of a few microns across. Nanoindentation has been shown to be an effective technique to determine the mechanical properties of microstructures at the micron scale. However the effects of anisotropy on nanoindentation have not generally been addressed. This study presents a method, which accounts for the effects of anisotropy on elastic properties measured by nanoindentation. The method is used to correlate elastic properties determined from earlier ultrasonic velocity measurements with recent nanoindentation results in human tibial cortical bone. When the effects of specimen drying are taken into account, the results from nanoindentation and ultrasonic velocities agree within experimental uncertainty.

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