Application Note: Certified Hardness Block

Overview

A reference block for Vickers microhardness was tested with a Nanoindenter XP using a Berkovich indenter. The certified Vickers hardness for the block was 153 kg/mm^2. Nanoindentation was performed in accordance with ISO 14577-1 using the same load at which the block was qualified.

The Vickers hardness and Young's modulus were measured by nanoindentation as (N = 12):

- HV = 150.0 ± 2.4 kg/mm^2
- E = 86.0 ± 1.6 GPa

Nanoindentation can be used to make accurate, repeatable, and fully automated measurements of Vickers microhardness at any scale.

Figure 1. Wilson® hardness test blocks
Image credit: Buehler

Procedure & Analysis

Reference blocks are routinely used to qualify microhardness testers. We acquired one of these blocks to test with a nanoindenter: HV 153 0.05. The number 153 is the reference value for Vickers hardness in kg/mm^2. The number 0.05 is the load, in kg, at which the block was qualified.

A Nanoindenter XP fit with a Berkovich indenter was used for all testing. The Berkovich pyramid is a 3-sided analogue of the 4-sided Vickers pyramid.

Twelve (12) indents were performed to a peak load of 500mN in accordance with ISO 14577-1. This testing load caused an indentation depth of about 3.5μm. Individual indentations were separated by 75μm.

Two important aspects of calculating contact area must be noted: 1) The contact depth was calculated as equal to the penetration depth, and 2) the area function for the diamond indenter was limited to two terms, with the first term being directly measured with a laser goniometer by the indenter manufacturer.

Significance

Vickers microhardness is the most common mechanical test the world over. It is used to qualify the surfaces of industrial parts and to characterize new materials, especially metal alloys and ceramics.

Nanoindentation radically simplifies and accelerates the measurement of Vickers microhardness. With nanoindentation, the contact area is inferred from the continuous load and depth measurements. The most difficult part of traditional microhardness testing—measuring diagonal lengths—is altogether unnecessary. Because diagonals don't have to be measured, nanoindentation is completely automated and can be done with much smaller loads. In addition, nanoindentation obtains Young's modulus from the elastic recovery sensed during unloading.

Getting started

To discuss nanoindentation testing of your materials, contact Jennifer Hay at Applied Nanometrix at 865-804-9721 or Jennifer@appliednanometrix.net.