Guidelines for NIST Nanoindentation Round Robin, Copper on Silicon, April 19, 2005

Assume that a colleague or customer has requested a measurement of hardness and modulus on two specimen materials. This hypothetical customer is not interested in or qualified to tell you how to do the measurements; he or she only wants the result, along with a concise statement of how the result was obtained.

Use nanoindentation to obtain the room-temperature hardness and modulus of both specimens: platinum-passivated copper film on silicon substrate and uncoated substrate, supplied. Use what you consider to be the appropriate measurement procedure. Specific recommendations for the test setup are listed below. If you would like to use more than one test method or test condition, please do, and report each separately. Please return your results within 6 weeks of receipt of the specimen.

Please transmit your test description and results, including the items listed on the form below, by filling out the web form at:

www.boulder.nist.gov/div853/nirr/results

OR
By e-mail to:
read@boulder.nist.gov
OR
By fax to:
USA 303 497 5030
Attention: D. T. Read
OR
By post to:
David T. Read
National Institute of Standards and Technology,
Mail Stop 853.08
Boulder, Colorado 80305-3328
USA

Thank you for your participation.

Report of Test Description and Results for NIST Nanoindentation Round Robin, Copper on Silicon, April 19, 2005

Principal Investigator:

Organization:

Date of test:

SPECIMEN: 2 chips, labeled RRCuOnSi and RRSub

The Cu is coated with a platinum layer for passivation, so it appears metallic or silver in color, not copper-colored. The underside of both chips has a relatively smooth matte appearance—please make sure to test the smoother, more reflective side.

Please do not return the specimens to me.

RECOMMENDATIONS FOR TEST SETUP:

Note: *Some copper films are known to anneal at low temperatures; some researchers use a "hot mount" procedure to mount their small hardness specimens. If you heat the specimens during mounting, please include in your report an estimate of the time and temperature seen by the specimens.*

Report hardness under load, that is, applied force divided by projected contact area under load.

Depth for evaluation of results: one-fifth of the film thickness, = 0.3 micrometer, based on recent reports in the technical literature.

Number of indentations, 10 or more.

Value of Poisson's ratio for copper = 0.344,
based on G. Simmons and H. Wang, *Single Crystal Elastic Constants and Calculated Aggregate Properties, A Handbook*, MIT Press, Cambridge, 1971.

RESULTS, please give as:

Indentation hardness:	Value: Uncertainty (1 standard deviation)
Indentation modulus:	Value: Uncertainty (1 standard deviation)

CONDITIONS OF THIS MEASUREMENT, please give as:

Estimated temperature of the specimen and exposure time, if a “hot mount” procedure was used:

Penetration depth used for evaluation of results:

Number of indentations averaged:

Poisson’s ratio value used:

Indenter tip geometry type (*e.g.*, Berkovich, spherical, *etc.*):

General assessment of the tip condition (please choose):

New, near new:

OR
Used:

OR
Heavily used

Tip bluntness, please give as tip radius in nanometers if available:

APPARATUS, please give as:

Make and model of commercially-obtained instrument:

OR
Literature citation:

OR
Brief description:

EXPERIMENTAL METHOD, please give as:

Title, version, and source of a commercially-supplied procedure:

OR
Literature citation:

OR
Brief description:

ANALYSIS METHOD, please give as:

Title and version of commercially-supplied software:

OR
Literature citation, including values of parameters used:

OR
Brief description, including values of parameters used:

MOST RECENT INSTRUMENT CALIBRATION, please give as:

Estimated date of factory calibration:

OR
Estimated date of on-site calibration by personnel outside the host organization:

OR
Types and dates of calibration procedures applied, such as:

Force calibration;

Displacement calibration;

Tip area function measurement;