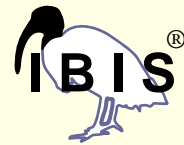


Feature Article #8

Some techniques in nanoindentation

Do more with your IBIS system

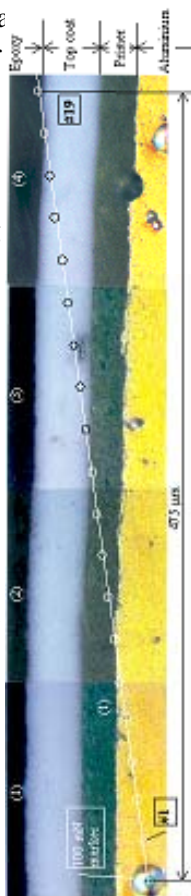


Introduction

The most popular application of nanoindentation is in the testing of hard thin films and methods of performing this test are well known. In this article, we have a look at some less well-known techniques which can prove very useful for other applications.

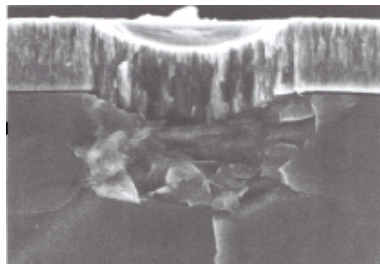
Polymer films

Nanoindentation can also be used in the micron penetration depth scale for testing thick films – the most obvious example being paint. The figure below shows how a paint/primer/substrate system can be tested in cross-section with the precise positioning capability of the instrument. A greater number of data points within each layer can be obtained by performing the indentations on an angle. This method has the advantage over the usual top-down through-thickness approach because each indentation is contained entirely within the layer with no “substrate effect”



Sub-surface cracking

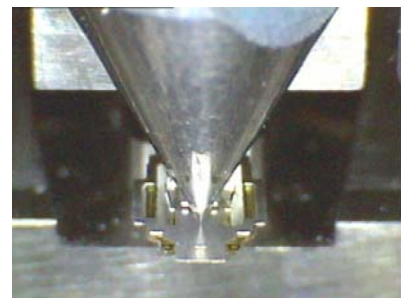
One of the great strengths of nanoindentation is a precise control over the load applied to the indenter. With a spherical indenter, this is particularly useful because unlike a Berkovich or pyramidal indenter, the “indentation strain” in the specimen can be gradually increased. Of particular interest in the semi-conductor industry is mechanical properties of silicon.



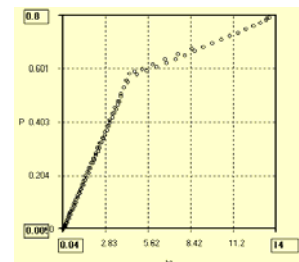
The figure above shows a sectioned view of a spherical indentation in a TiN coated specimen of silicon showing how even though the coating appears indented, but intact, the underlying silicon substrate has been badly cracked and this would lead to a substantial decrease in mechanical strength of the structure as a whole. This type of mechanical testing can be useful in determining the recommended in-service loads for such structures this leading to greater reliability of the finished product.

MEMs testing

A small number of nanoindentation instruments have a closed loop depth control capability.



The figure above shows how the indenter tip can be brought down into contact with a micron-sized cantilever (in this case, a hard disk read-write head) and then the stiffness of the structure measured. The arrangement of dimples and gimbals in the structure is designed to change the stiffness depending on the total deformation of the structure.



Conclusion

Nanoindentation testing is not just about measurement of elastic modulus and hardness, but can also be used for a variety of applications where precise control of the load and the indenter position is required. This type of instrument is an ideal micron-to nano scale mechanical tester.