

APPLICATION NOTE

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MEMs TESTING

APPLICATION

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AUTHOR

INTRODUCTION

Last year, a customer approached us with a need to test a specific type of micro-electro-mechanical (MEM) structure. This application note briefly describes the successful solution achieved using the NANO **Indenter XP** and **TestWorks® EXPLORER**.

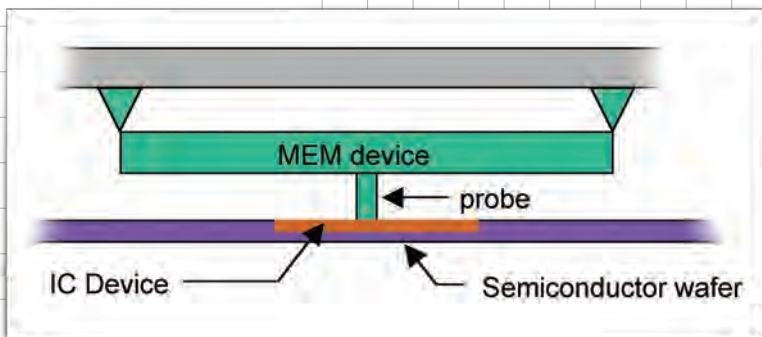


figure 1: Schematic of a MEM device in use.

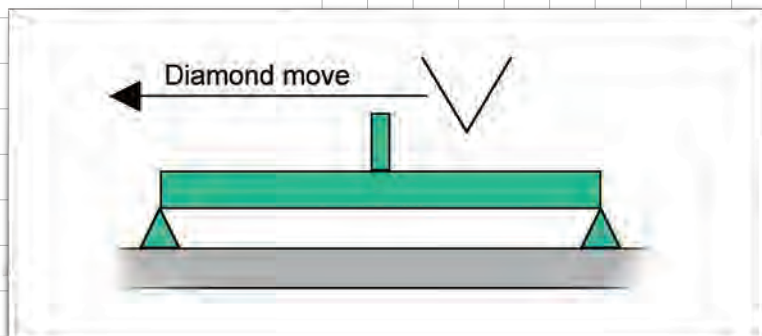


figure 2: Schematic of test. Cube-corner face shears through probe tip.

THE PROBLEMS

The structure of interest was a semiconductor circuit probe. Arrays of these probes are used to test devices on semiconductor wafers. A schematic of the device in use is shown in [figure 1](#), and a photo of the device before testing is shown on the left-hand side of [figure 3](#) (in this photo, the probe tip points out of the plane of the page). In an effort to predict in-service performance, the customer needed a test that would measure the maximum lateral force that could be sustained by the probe tip before breaking.

THE SOLUTION

From our line of indentation systems, the NANO **Indenter XP** was selected as the hardware base due to its unique combination of robust construction, large displacement travel (2 mm), and excellent resolution in both force and displacement (50 nN and 0.01 nm, respectively). A cube-corner diamond pyramid was installed as the indenter tip. **TestWorks EXPLORER** was used to develop a new test method. The test method contained instructions to:

- ▣ Laterally move the indenter with respect to the structure (as shown in [figure 2](#)) so that the face of the diamond pyramid would contact and shear through the probe tip,
- ▣ Continuously measure the lateral component of the contact force between the indenter face and the probe tip, and
- ▣ Report the maximum lateral force encountered during the test.

THE RESULT

[Figure 3](#) shows a structure before and after the test described above; the probe tip has been sheared off, but the rest of the structure is clearly intact. [Figure 4](#) is another before-and-after combination. [Figure 5](#) shows lateral force as a function of move position for a single test. At the left-most side of the graph, the indenter face begins to approach the sample. When it hits, the lateral force of the contact increases until the probe

RELATED PRODUCTS:



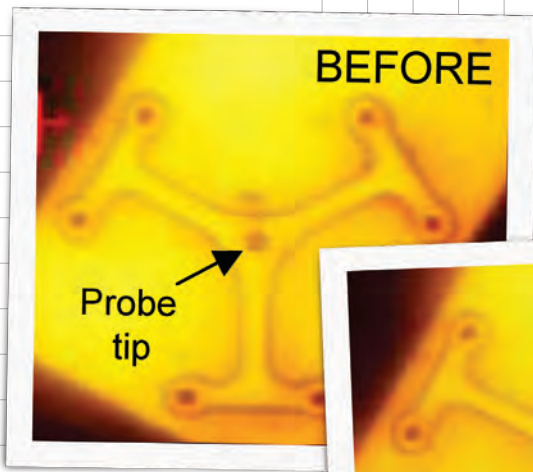


figure 3: MEM structure before and after shear test. Probe is missing.

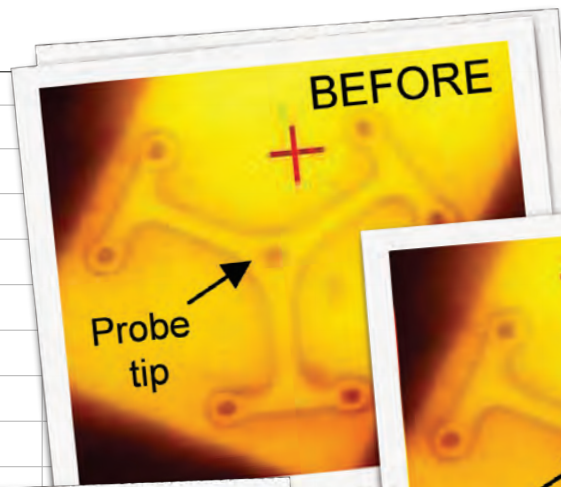
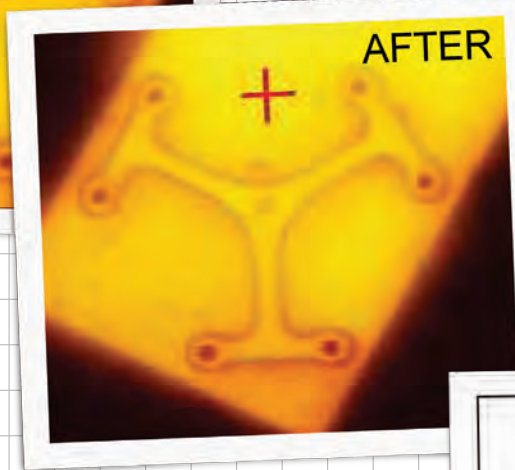


figure 4: MEM structure before and after shear test. Failed probe is still visible.



tip bends or breaks and loses contact with the indenter. This test was repeated on 25 different structures. For all 25 of these tests, failure of the probe alone was confirmed optically. The force at failure was 0.49 ± 0.04 mN (error represents 1σ).

CONCLUSIONS

With the power of **TestWorks EXPLORER**, the **NANO Indenter XP** becomes a general, small-scale mechanical testing tool that is unparalleled in ex-

perimental flexibility and control.

With **TestWorks EXPLORER**, you have access to all of the test-development software tools used by the engineers at the **MTS NANO Instruments**. Tutorials and classes are available to help you in your use of **EXPLORER**, and nearly all method writing involves modifying an existing method that performs a similar function. Our engineers are able and willing to work with you in the development of custom **TestWorks** methods to suit your unique testing needs.

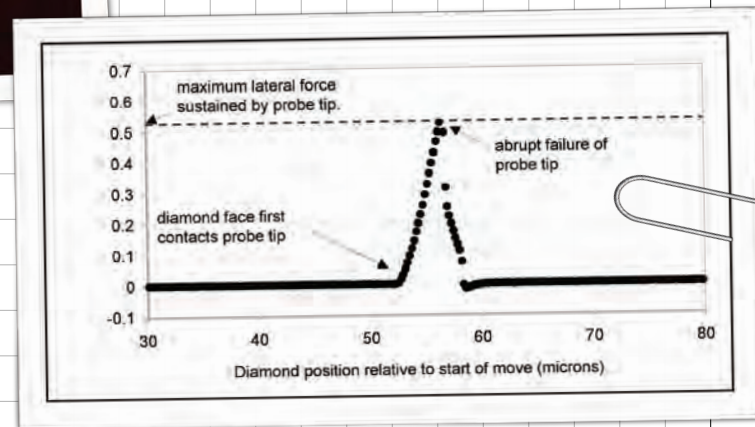


figure 5: Lateral force data from a typical test. At the left-most side of the graph, the indenter face begins to (laterally) approach the sample. When it hits, the lateral force of the contact increases until the probe tip bends or breaks and loses contact with the indenter.



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