A Silicon-etched, Electrical-contact Tester

A.C. Weber, A.H. Slocum, J.H. Lang
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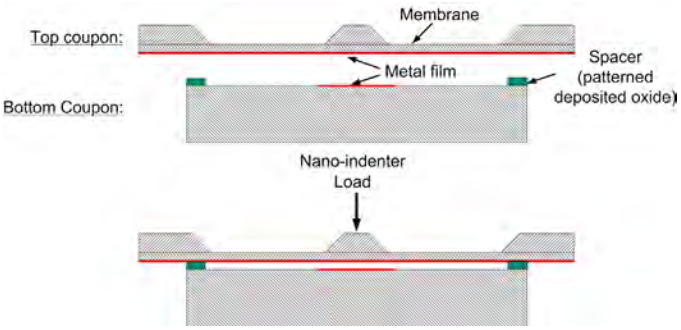
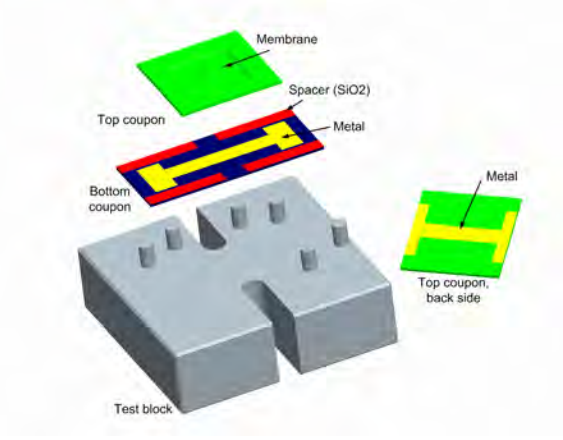
We are developing a bulk micromachined contact tester to investigate the electro-tribological performance of micro- and nano-structured planar electrical contacts [1]. The test device features parallel, planar, nanometer-scale surface roughness contacts etched in silicon coated with thin conductive films. Contacts used in microsystems, probes and interconnects are subject to heat dissipation and to electro-mechanical tribological effects. With an understanding of how nanoscale surface and subsurface material structure affect electrical contact resistance and mechanical contact wear, a deterministic manufacturing process could be developed to design electrical contacts from crystalline plane surfaces as potential high performance contacts for MEMS devices and related applications.

The microfabricated contact tester, shown in Figure 1 and in Figure 2, consists of a pair of parallel planar contact surfaces with nanometer roughness patterned onto two (100) Si substrates. Anisotropic etching is used on one of the substrates to create a membrane that serves as a compliant mechanism for the contact tester. A thin conductive film, i.e., Au, is patterned onto the contacts in a Kelvin configuration. The two-piece tester architecture allows for inspection of the contacts before, during, or after testing without destruction of the test device. In one embodiment of the tester, a quasi-kinematic coupling enables the alignment between the substrates while providing the initial gap between the contacts. Similar quasi-kinematic designs fabricated in silicon substrates have reported repeatability on the order of 1 micrometer [2]. In a second embodiment of the MEMS-tester a patterned oxide film is used to provide the initial space between the contacts. The tester will be loaded using a commercial nanoindenter to bring the surfaces into contact as contact resistance is measured as a function of the force.



▲ Figure 1: Schematic view of the contact tester.



▲ Figure 2: Exploded view of the contact tester. The back side of the top coupon indicates the patterned metal used for the Kelvin contact configuration.

REFERENCES

[1] A.C. Weber, G. Bassiri, B.M. Dvorak, A.H. Slocum, D.A. Lucca, and J.H. Lang, "Atomic Plane Electrical Contacts", in *Proceedings of the 7th European Society of Precision Engineering (EUSPEN) International Conference*, Bremen, Germany, May 2007

[2] A.H. Slocum and A.C. Weber, "Precision passive mechanical alignment of wafers," *Journal of MEMS*, vol. 12, no. 6, pp. 826-834, Dec. 2003