Polytec

Semiautomatic MEMS Test

Field of Application

A Aerospace
B Audio & Acoustics
C Automotive
D Data Storage
G General Vibrometry
M MEMS & Microstructures
P Production Testing
S Scientific & Medical
T Structural Testing
U Ultrasonics

Semiautomatic, Wafer-Level Measurements of MEMS Dynamics

Micro Electro-Mechanical Systems (MEMS) find numerous applications in the automotive, medical, biochemical and aeronautic industries. Wafer-level MEMS testing prior to packaging is an increasingly important measurement for achieving high yield and reliability at low production cost. Measuring the response of a MEMS device both to changing environmental conditions like pressure, light, temperature and fluids and to intrinsic parameters like resonance frequencies and displacements is crucial to the dynamic design of new sensors. In this application note we will describe a setup for characterizing the dynamic response of membranes using a semiautomatic probe station equipped with a scanning laser-Doppler vibrometer.

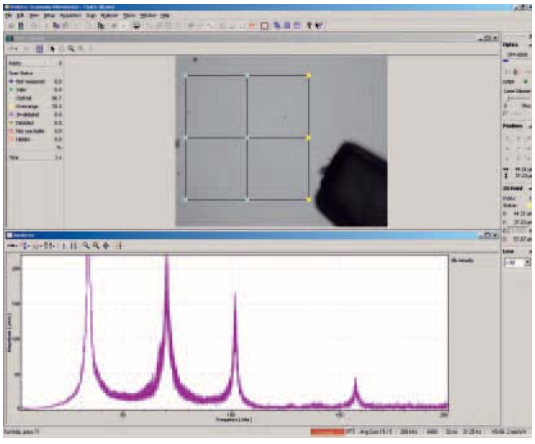

Figure 1: Measurement grid (top) and frequency spectrum (bottom) of the device displayed in the Polytec Scanning Vibrometer Software

Step-and-Repeat MEMS Wafer Testing

Dynamic testing of a MEMS wafer covered with an array of micro-membranes is time consuming and tedious when it is done manually, one device at a time. To improve the throughput, a semiautomatic probe station, to position the wafer, and a laser-Doppler vibrometer, to perform the dynamic test on each device, were combined. The entire characterization process is controlled by software that steps the wafer and then intiates a measurement. The complete system (title image) consists of the Polytec MSA-400 Micro System Analyzer hardware running the Scanning Vibrometer Software, a SUSS PA200 Probe Station equipped with the MSA-400 Measurement Microscope Head, the probe station controller hardware, and the SUSS ProberBench™ Operating System.

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The first step is to align the wafer, which programs the locations of the structures on the wafer. With this information, the software generates a wafer map. The next step is to define the measurement parameters for the vibration characterization of the membrane. For the membrane array MEMS device, a grid consisting of 6 to 9 measurement points (Figure 1, top) is fitted to a single membrane structure. After these two steps, the software is ready to initiate the step-and-repeat measurements on the MEMS device.

Beginning at the first membrane, the system steps to each membrane on the wafer as originally programmed. On each membrane, a scanning vibrometer measurement is performed within 2 to 3 seconds (Figure 2 and Figure 1, bottom) and saved together with the device ID. As a result, the full wafer map is measured and frequency spectra as well as deflection shapes of all devices are available (Figure 3).

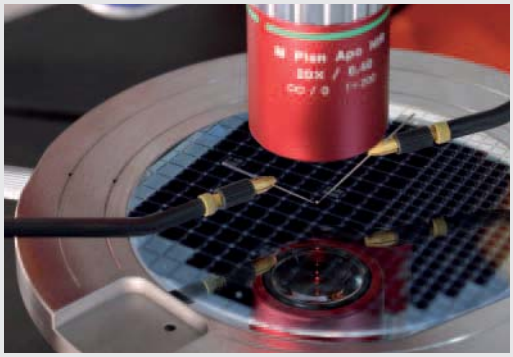

Figure 2: Scanning laser-Doppler vibrometer measurement of a single MEMS membrane on the wafer

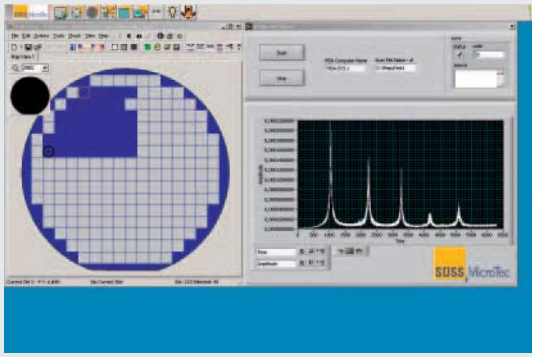

Figure 3: Wafer testing process and vibration signal displayed in the SUSS ProberBench™ Software

SUSS PA200
Semiautomatic Probe System for Direct MEMS Testing at Wafer-Level

The SUSS PA200 is a precise and flexible semiautomatic test solution for wafers and substrates up to 200 mm. It is ideal for failure analysis, high frequency measurements, as well as for opto-mechanical engineering, and MEMS tests. The PA200 ensures reliable probing and precise measurements on decreasing pad and feature sizes down to the submicron range. Its modular design concept allows for mounting microscopes based on the requirements of the application and for upgrading the PA200 from a simple manual microscope stage to a fully programmable microscope with high magnification. Available accessories include: laser cutters, specially designed chucks for HF measurements, as well as probe card adapters. The PA200 is controlled by the unique SUSS ProberBench™ operating system, which consists of an electronics rack, a joystick controller for full prober control, and a graphical user interface. ProberBench™ interfaces with test equipment and software from all leading vendors. Find more info on **www.suss.com**

Polytec Micro System Analyzer
For Measurements of 3-D MEMS Dynamics and Topography

The Micro System Analyzer series was developed ex-pressly for the analysis and visualization of structural vibrations and surface topography in microstructures such as MEMS devices. For wafer-level testing, the MSA is easily mounted onto manual or fully automated probe stations. By fully integrating a microscope with scanning laser-Doppler vibrometry, stroboscopic video microscopy and white light interferometry, the MSA is an all-in-one combination of technologies that clarifies real microstructural response and topography. Incorporated in the MEMS design and test cycle, the MSA provides precise 3-D dynamic and static response data that simplifies troubleshooting, enhances and shortens design cycles, improves yield and performance, and reduces product cost.

In addition to the MSA-400 used for this measurements, the new MSA-500 has an Autofocus and Geometry Scan that widen the vertical measurement range and allow a complete 3-D view of the vibrations.

Please find more information on
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