Reliable to the nanometer

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Small fault – major impact. Disruptions to production are often caused by electronic faults. They arise because no reliable measurement and testing methods exist for the ever-smaller dimensions of microchip components. Material tests for the nanocosmos provide a solution.

Microelectronic components are shrinking from one generation to the next. A problem exists, however, in that the material used often behaves quite differently in the micro- or nanocosmos than in the macroscopic world. Hardly any reliable data exists for this environment. In order to assess service life and quality, established techniques need to be combined with innovative concepts. One example is nanoDAC, a testing method developed by scientists from the Fraunhofer Institute for Reliability and Microintegration IZM in Berlin.

DAC stands for deformation analysis through correlation methods, and analyses materials at the nano- to micro-level. Up to now it has mainly been used in electronic assembly and connection technology to test solder joints, find cracks in PCB material or identify internal stresses in micromechanical actuators and sensors. “The significance of these tiny components is often underestimated,” insists IZM head of department Bernd Michel. “A solder point or a small sensor does not cost much, so why go to all the effort of testing? If they fail, however, they can cause heavy financial losses.”

At the heart of the system is an atomic force and scanning electron microscope that takes pictures of materials under various loads. A software program makes it possible to reproduce an almost atom-precise

image of the sample and its faults. “Images of the critical areas of a component are compared with each other in order to identify changes and faults,” explains Dietmar Vogel. “Depending on the load, shifts in local image patterns are discernible.

A tiny crack can thus be identified although it cannot be recognized with certainty even in a microscopic image.” One special variant of the system is the fibDAC technique (FIB stands for Focus Ion Beam). This identifies internal stresses in the smallest dimensions, which offers interesting potential for microchip manufacture because internal stresses and their control play an important role in the development of new computer generations. Bernd Michel, Dietmar Vogel and Jürgen Keller designed the system and took it from the initial idea through to the marketable measurement technique.

They have been awarded the Joseph-von-Fraunhofer Prize in recognition of their achievement. The international response is proof enough of the widespread demand for such a testing method. Companies such as Infineon, BMW and Ford, as well as Bosch, TEMIC and Motorola, have already conducted material tests on a micro- and nanoscale or are planning to do so.

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