

Nanometrology with and for MEMS/NEMS technology

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Nanotechnology, as the scientific and technological discipline dealing with the design, fabrication and application of systems whose dimensions or tolerances are in the domain of nanometers, is becoming increasingly important in many industrial and scientific areas. The progress in Nanotechnology is directly connected with the progress in the Micro-Electro-Mechanical Systems (MEMS) technology. In general it can be described as a technology miniaturized electro-mechanical devices and structures that are fabricated using the modified semiconductor device fabrication techniques, normally used to manufacture integrated circuits (ICs). The critical physical dimensions of the MEMS devices, to which belong simple structures having no moving elements and extremely complex electromechanical systems with elements actuated and controlled by the integrated microelectronics, can vary from several microns to several millimeters. The MEMS usually integrate precise analogue electronics and microprocessors that process signals from the microsensors and control the operation performed by the microactuators. The MEMS technology requires not only application of modern microfabrication techniques but also thorough analysis of the system operation. It should be noted, that the analysis based on classical physics cannot often be used to describe and interpret the phenomena defining the functionality the MEMS device. At these scales of dimensions the large surface area to volume ratio of the MEMS devices, surface effects such as electrostatics, wetting, molecular adhesion, which includes chemical interactions, dominate volume effects such as inertia or thermal mass. In a natural way the MEMS technology merges at the nanoscale into Nano-Electro-Mechanical-Systems (NEMS) and nanotechnology. As to create in nanotechnology viable, commercial products, ultra-precision metrology is and will be required to stimulate and support scientific and technological progress. We refer this new metrology as “Nanometrology” (in other words Metrology of micro- and nanostructures). In our opinion the metrology done with/and MEMS and NEMS devices is the solution of many scientific technological issues.

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