

NIST Perspectives on Metrology Needs to Support Emerging Technologies

Plática Plenaria

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ABSTRACT

Metrology has played a fundamental role in the industrial revolutions of the past few centuries and has enabled new technologies to emerge. Measurements at the milli-inch length scale, through such devices as vernier calipers and gauge blocks, provided the basis for heavy industry mass production. Through technologies such as laser interferometry, measurements at the micrometer length scale became possible. These capabilities enabled the development of integrated circuits, computers and the internet which sparked the semiconductor revolution during the last half century. As nanoscale measurement capabilities have developed, it is often asserted that we are standing at the threshold of another industrial revolution in nanotechnology. Nanoscale measurements and technologies are not simply a continuation from the microscale; rather these measurements and technologies provide capabilities to understand molecular behavior and to discover new physical and chemical properties of materials. This new knowledge is beginning to have a profound impact on many emerging technologies in fields such as chemistry, biosciences, and manufacturing. However, if molecular level and nanoscale measurements are to spur another revolution, a metrology infrastructure, at and below the nanometer level, must be fully developed.

Unfortunately, the existing metrology infrastructure may not be adequate, and measurement barriers to emerging technologies that exploit the molecular and nanoscale continue to exist. New measurement technologies are required to develop fundamental knowledge and to overcome limitations in measurement accuracy, resolution, sensing and detection capabilities. Limitations arise because many measurement technologies are reaching the limits of their capabilities, and/or technological advances and societal change are demanding entirely new measurement capabilities at the expense of improving existing technologies. Through its research laboratories and international collaborations, the National Institute of Standards and Technology (NIST) in the United States, is working to advance measurement science, standards, and technology to help overcome measurement barriers in several emerging technologies. NIST is working to improve accuracy and resolution for molecular level and nanoscale measurements critical to the biosciences, chemistry, health care, electronics (semiconductor and non-semiconductor), information technology, telecommunications, nanotechnology, and materials sciences and industries. NIST has research programs and initiatives to improve sensing and detection capabilities in many diverse fields by developing new science, materials and technologies including the unique applications of nanotechnology, biotechnology, and advanced electronics.