Nanometrology: Fundamental for Realizing Products at the Nanoscale

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Advanced nanomanufacturing is important to the strength and growth of the U.S. manufacturing sector, and a strong measurements and standards infrastructure is vital for its success. Within the next 10 years, at least half of the newly designed advanced materials and manufacturing processes are predicted to be built at the nanoscale, and advanced measurement science (metrology) and instrumentation will be essential. If you cannot measure it you cannot make it. Successful metrology infrastructure is essential for manufacturers to achieve the real promise of newly developed nanomaterials, devices, and products. Instrumentation provides the data upon which sound scientific conclusions can be based, and correct metrology allows us to properly and accurately interpret those data. Together they facilitate nanomanufacturing.

Nanomanufacturing requires new process measurement and control systems that can span various size scales while accounting for the unique physics that governs the device and its interaction with the environment at each scale. In addition, nanomanufacturing must take into account that the nanoscale components have unique mechanical, electronic, magnetic, optical, and chemical properties that dominate their behavior and represent a scale of matter at which radically different phenomena are manifested. Measurements must determine where and when these unique properties begin to manifest. The success of nanomanufacturing will rely on a combination of theoretical (analytical and computational) and experimental tools that address predictability, producibility, and productivity in manufacturing at the nanoscale. Some aspects of nanomanufacturing will require novel manufacturing methods that deviate from the relentless scaling down of currently practiced technologies such as the semiconductor industry. This presentation will address some of these issues.