

Materials Property Measurements

This program responds both to MSEL customer requests, and to the DOC 2005 Strategic Goal of “providing the information and framework to enable the economy to operate efficiently and equitably.” For example, manufacturers and their suppliers need to agree on how material properties should be measured. Equally important, engineering design depends on accurate property data for the materials that are used.

The MSEL Materials Property Measurement Program works toward solutions to measurement problems on scales ranging from the macro to the nano, in four of the Laboratory’s Divisions (Ceramics, Materials Reliability, Metallurgy, and Polymers). The scope of its activities goes from the development and innovative use of state-of-the-art measurement systems, to leadership in the development of standardized test procedures and traceability protocols, to the development and certification of Standard Reference Materials (SRMs). A wide range of materials is being studied, including polymers, ceramics, metals, and thin films (whose physical and mechanical properties differ widely from the handbook values for their bulk properties).

Projects are directed to innovative new measurement techniques. These include:

- Measurement of the elastic, electric, magnetic, and thermal properties of thin films and nanostructures (Materials Reliability Division),
- Alternative strength test methods for ceramics, including cylindrical flexure strength and diametral compression (Ceramics Division),
- Coupling micromechanical test methods with failure behavior of full-scale polymer composites through the use of microstructure-based object-oriented finite element analysis, in collaboration with the Automotive Composites Consortium.

The MSEL Materials Property Measurement Program is also contributing to the development of test method standards through committee leadership roles in standards development organizations such as ASTM and ISO. In many cases, industry also depends on measurements that can be traced to NIST Standard Reference Materials (SRMs). This program generates the following SRMs for several quite different types of measurements.

- Charpy impact machine verification (Materials Reliability Division), and
- Hardness standardization of metallic materials (Metallurgy Division)
- Hardness standardization and fracture toughness of ceramic materials (Ceramics Division)
- Supporting the Materials Property Measurements Program is a modeling and simulation effort to connect microstructure with properties. The Object-Oriented Finite-Element (OOF) software developed at NIST is being used widely in diverse communities for material microstructural design and property analysis at the microstructural level.

In addition to the activities above, the Materials Reliability, Metallurgy, Ceramics, and Polymers Divisions provide assistance to various government agencies on homeland security and infrastructural issues. Projects include assessing the performance of structural steels as part of the NIST World Trade Center Investigation, advising the Bureau of Reclamation (BOR) on metallurgical issues involving a refurbishment of Folsom Dam, advising the Department of the Interior on the structural integrity of the U.S.S. Arizona Memorial, advising the US Customs Service on materials specifications for ceramics, and advising the Architect of the Capitol on repair procedures for cracks in the outer skin of the Capitol Dome.