

Overview of the Sensor Science and Technology Group

The Sensor Science and Technology (SST) Group conceives, designs, develops, tests, and deploys prototypic sensors and systems for applications that advance science, improve energy efficiency, or enhance national security. Specializing in harsh environment sensors (Figure 1), sensor systems integration, and solving multidisciplinary measurement problems, SST has a long history of innovation and commercialization of sensors.



Fig. 1. Thermoluminescent nano-powders for harsh environment temperature sensing.

One area of focus for SST is sensors and systems for energy efficiency applications. Figure 2 shows a microelectromechanical systems (MEMS) sensor array that was part of a building monitoring system capable of measuring temperature, humidity, CO₂ levels, and occupancy (infrared detection) as an integrated system.



Fig. 2. MEMS sensor array building environment monitoring.

Sensor technologies for national security applications is another area of emphasis for SST. Laser-based remote sensing, chemical and biological detection, and advanced radiological and nuclear detection systems are part of our portfolio of technologies. Figure 3 depicts a laser scanning system that was developed and commercialized for safeguards and security monitoring applications.



Fig. 3. Laser-based item monitoring system for high-value storage environments.

We also have extensive experience with electrochemical sensors for power generation diagnostics, carbon sequestration monitoring, and automotive engine controls.

Capabilities

In the last decade SST has been a leader in the development of novel sensor technologies at the Oak Ridge National Laboratory (ORNL). These efforts have led to more than 25 patents, three R&D 100 Awards, and a spin-off company.

SST's areas of technical expertise include

- acoustic sensors and imaging systems;
- flow measurement;
- ultra-precision displacement;
- radiation detectors (Figure 4);

The Next
Generation of
Sensors and
Measurement
Systems

Purpose: Apply first principles physics, chemistry, biology, electronics, and mechanics in the development of novel sensors and systems of national importance.

Sponsors: Department of Energy, Department of Defense, U.S. Department of Homeland Security, and private industry.

Features:

- Multidisciplinary research staff including physicists, electrical engineers, materials scientists, mechanical engineers, and software engineers.
- World-class R&D laboratories.

Complementary ORNL Facilities:

- Spallation Neutron Source.
- Center for Nanophase Materials Sciences.
- National Center for Computational Sciences.
- High Temperature Materials Laboratory.

Contact Information:

Timothy J. McIntyre
Group Leader
Oak Ridge National
Laboratory
P.O. Box 2008
Oak Ridge, TN 37831-
6075
Phone: 865-576-5402
Fax: 865-574-1249
(mcintyre@ornl.gov)



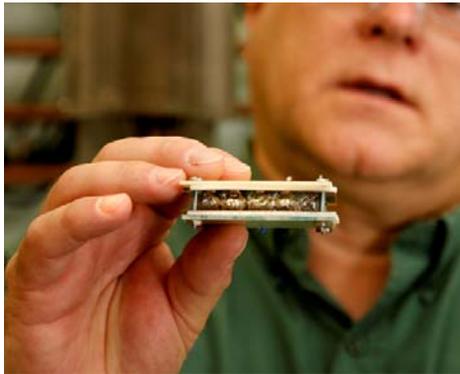


Fig. 4. Advanced neutron detector arrays.

- laser-based sensors and systems (fiber optic, Fabry-Perot, and spectroscopic [Raman, LIBS, PIS]);
- electrochemical sensors (Figure 5);

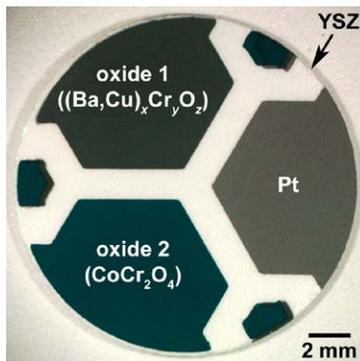
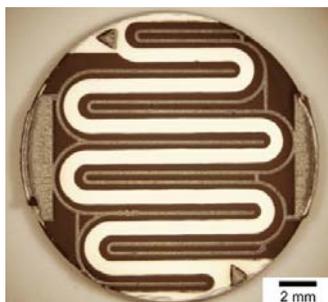


Fig. 5. High-temperature electrochemical sensor designs for CO_2 , NH_3 , SO_x , and NO_x measurements.

- electromagnetic sensors, including electromagnetic acoustic transducer, piezoelectric, magnetostrictive, capacitive, inductive, and Hall effect;
- temperature sensors, including luminescence-based, Johnson noise, infrared, microbolometric, and MEMS-based;
- ultra-precision dimensional measurements, profilometers, and metrology;
- testing and analysis for prototypes; and
- standards development (Figure 6).

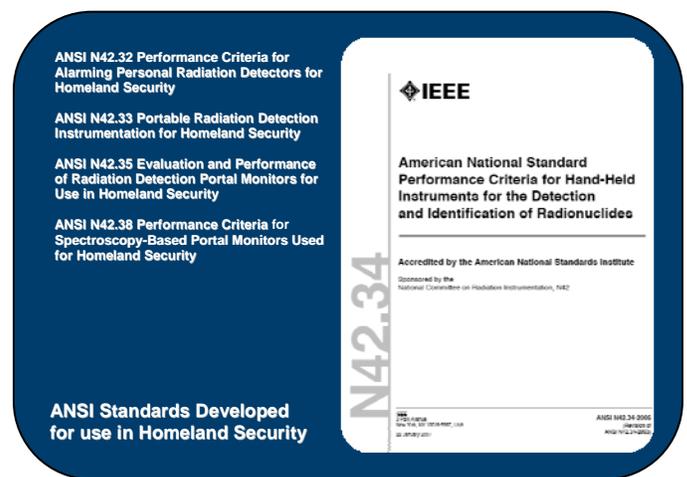


Fig. 6. International standards developed for testing and evaluation of radionuclide detectors by SST staff.

Additional Nearby Facilities

- Center for Nanophase Materials Sciences is a collaborative user research facility for the synthesis, characterization, modeling/simulation, and design of nanoscale materials for sensors.
- Research and development (R&D) laboratories in other research divisions at ORNL, including biology, chemistry, mechanics, materials, condensed matter science, environmental sciences.