

Sensor Development

The ability to quickly and accurately detect trace amounts of chemicals, bacteria, radioactive materials or viruses in air, water or soil is key to addressing many security, environmental and health issues. Boise State is on the forefront of efforts to fabricate new sensors with expanded capabilities.

DEFINITION

SENSORS are devices that measure specific physical or chemical conditions. They work by converting the measurement into an analog or digital signal that can be interpreted by users or by other instruments.

AT-A-GLANCE

SENSOR STRENGTHS in biomaterials, electrochemistry, magnetic materials, reconfigurable hardware, nanotechnology, photonics, nuclear materials and other fields

PATENTS AWARDED for Selective Mercury Electrode and for Electrical Field Flow Fractionation Using an Electrically Insulated Flow Channel; a number of sensor-related patents are pending

FIRST IN THE WORLD to deploy an ion mobility spectrometer below ground, and first to use a magnetic property as a sensing parameter for a new nanoscale sensor

2008 IDAHO INNOVATION AWARD for subsurface ion mobility spectrometer

NATIONAL RECOGNITION for student researchers and opportunities for employment on faculty projects

PARTNERSHIPS with industry, with other universities and with government agencies, including the Idaho National Laboratory

FAA CENTER of Excellence for Research in the Intermodal Transport Environment established at Boise State

MAJOR RESEARCH GRANTS from Environmental Protection Agency, National Science Foundation, U.S. Department of Defense, U.S. Department of Energy and other agencies, and industry funding from URS Washington Division and other firms

TOP ACADEMIC CREDENTIALS among outstanding faculty in chemistry, physics, civil engineering, biology, geology, electrical and computer engineering, materials science and engineering and other fields

PROJECTS

Sensors in various stages of development include:

- **PHOTONICS-BASED** sensors to measure multiple chemicals in vapor or liquid simultaneously
- **WIRELESS SENSOR** networks with reconfigurable hardware to monitor air quality and noise levels in aircraft cabins
- **PORTABLE SENSORS** to detect arsenic, mercury, plutonium and other contaminants in ground and surface water

- **BIOMOLECULAR** sensors to identify biological agents such as anthrax or for use in drug delivery systems
- **SUBSURFACE ION MOBILITY SPECTROMETER** to obtain real-time data on gaseous volatile organic compounds in unsaturated soils
- **NANOPARTICLE-BASED** sensors to detect biological species such as DNA, protein and bacteria
- **OIL SENSORS** to detect contaminants and water in airplane and automotive engines
- **MAGNETIC-BASED** sensors that detect contaminants based on changes in magnetic properties of materials
- **SENSOR PROJECTS** that utilize novel materials, wireless systems, nanoscale design, reconfigurable hardware and other advanced technologies



CAPABILITIES

Sensor research at Boise State offers opportunities for external collaborations and support ranging from design and fabrication to lab and field testing, modeling, and expertise in theory and technology transfer

"One of the most exciting aspects of sensor research is its interdisciplinary nature.

We work with colleagues with expertise in many different fields to solve complex problems related to sensor development. Our partnerships with other universities, with industry and with government also support our work."

— Dr. Darryl Butt (pictured at left)
Chair, Department of Materials Science and Engineering

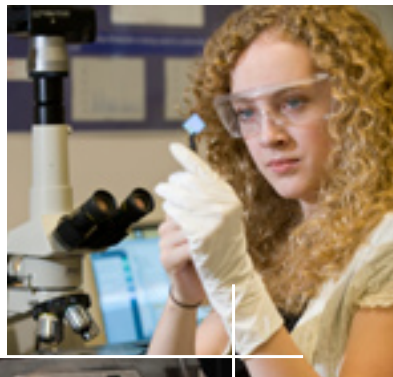


SIN MING LOO, PH.D.

Dr. Loo (pictured above at center) and his students have developed a wireless, reconfigurable and portable sensor system for monitoring and recording environmental conditions inside aircraft cabins, and in-flight testing of the system is now under way. The system includes a flexible hardware platform that can be easily reprogrammed to interface with different wireless sensors to detect and measure a wide range of conditions, including temperature, humidity, pressure, carbon dioxide and noise levels. The research is being conducted as part of the FAA's National Center of Excellence for Research in the Intermodal Transport Environment at Boise State.

DALE RUSSELL, PH.D.

Dr. Russell (pictured below) has two awarded patents and three pending patents for her research to develop portable sensors to detect trace amounts of mercury, uranium, arsenic, benzene and other substances in water; and mercury in crude oil. The sensors can be hand held or deployed long-term in the field. They can detect and measure specified contaminants and then rapidly transmit the data to remote locations. Dr. Russell is using a manufacturing technique invented with Dr. William Knowlton to make sensors with two different operating modes that can be miniaturized on an IC chip. In addition, Dr. Knowlton is co-inventor on one of the pending sensor patents.



STEPHANIE BARNES, JUNIOR FROM BOISE, IDAHO

Barnes began working on funded research at the end of her freshman year at Boise State, and she considers the experience to be one of the best parts of her college career.

"My goal is to earn a Ph.D. and get a job as a university professor, so doing hands-on research as an undergraduate is extremely helpful," said Barnes, who is majoring in materials science and engineering. She conducts research under the direction of Dr. Bill Knowlton, Dr. Bernard Yurke, Dr. Will Hughes and Dr. Elton Graugnard.

Barnes is part of a research team that is working to develop nanoscale sensors that utilize the self-assembly properties of DNA. By harnessing these unique properties, researchers hope to develop biological-based sensors that could be used inside the human body to detect and monitor diseases such as diabetes or cancer.

Barnes and several other students in a fabrication group are tasked with building nanoscale structures for use in a process called dielectrophoresis.

"The topics I study for my research and the ones I study in class aren't necessarily related. But the mindset I've gained from conducting research has been extremely valuable," Barnes said.

RESEARCH GRANTS

Here is a sampling of grants related to sensor research at Boise State:

Secure Wireless Ad-hoc Networking and Sensor Networking
National Science Foundation
\$82,344

In-Flight Sensor System Development and Deployment
Federal Aviation Administration
\$50,618

3-D Technology for Advanced Sensor Systems
U.S. Department of Defense
\$4.6 million

Sensors for Contaminants in Water in the Shallow Geological Subsurface, and Field Demonstration of a Subsurface IMS (two separate grants)
URS Corporation
\$150,000

Chemical Sensor for Cabin Air Quality
Federal Aviation Administration
\$150,000

Detector for Per technetate Ion in the Shallow Geologic Subsurface
U.S. Department of Energy (originating sponsor)
\$16,500



As an emerging metropolitan research university of distinction, Boise State University is committed to fostering an environment where exceptional research and creative activity thrive.

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