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Photonics Applications in the Environmental Sciences

A case study by [Avantes](#)



By [Avantes](#)

Ecosystems around the world face growing threats from industrialisation, growing populations, and increasing urbanisation. Climate changes also wreak havoc on emerging economies and have health and social implications. Not surprisingly, researchers, scientists and governments are investigating tools for monitoring and preventing these environmental hazards.

Industries and methods

As all sorts of industries advance in the global marketplace, the need for ecological monitoring technology advances as well. Several spectroscopic measurement techniques are proving to be very effective and versatile for environmental applications.

Contamination monitoring

Researchers with the Institute of Solar Energy at the Technical University of Madrid, Spain, trust the Avantes Ava-Spec 2048-USB2-UA in their research into the use of high-powered UV LEDs. These thermally stable bulbs are inexpensive and have a long bulb life, making them an attractive alternative as an excitation source for continuous use fluorescence sensing of aromatic hydrocarbons.

This work required mapping detection errors to degradation of optical output power and determined a degradation limit of 30%.

Researchers from the College of Control Science and Engineering at Zhejiang University are working to develop a fluorescence method for rapid, on-site water quality analysis. Their method employs fluorescence spectroscopy to establish a model of a “normal” water sample. Working with an excitation wavelength of 350 nm and an emission wavelength of 397 nm, the researchers believe they were able to establish a model to detect the presence of unknown organic contaminants with fluorescent characteristics.

The work of these researchers contributes to the development of real-time, in-situ, and continuous water quality monitoring systems.

The use of laser induced breakdown spectroscopy is widely used for soil contamination detection. Researchers from the Department of Environmental Sciences of the Government College University, Faisalabad, Pakistan are studying Chromium VI and other heavy metal contamination. Industrial waste produced by the economically important leather tanning industry is a significant concern. The Avantes AvaSpec 3648-USB2 Dual Channel spectrometer system working in the 300-750 nm wavelength range provided researchers with quantitative and qualitative analytical data with a very low detection limit.

Spectroscopy in nuclear materials monitoring

Nuclear power is used around the world to supply commercial and residential power demands without the same carbon footprint of coal fired power. But nuclear power comes with its own risks. Researchers



came together from institutions in Finland, Estonia, Romania, and Germany to study detecting doped samples of deuterium in composite samples of beryllium and tungsten. This work will contribute to the development of in situ monitoring of deposit layers in plasma-facing surfaces of fusion reactors, improving safety and efficiency.

“our innovative designs and commitment to advancing the science of photonics means that Avantes spectrometers are built to handle the new and innovative uses researchers are finding for spectroscopy”

At the Savannah River National Laboratory plutonium processing site, Avantes instruments are at the core of recent monitoring system

upgrades. The new Savannah River spectrophotometer monitoring system replaces colorimeters used to determine plutonium concentration in solution. In addition to being considerably more accurate, the new system is easier to troubleshoot, calibrate, and repair, leading to less downtime and improved safety.

Oceanographic research

The world's oceans produce more than half of the oxygen in our atmosphere. Protecting our oceans is vital and researchers are increasingly using spectroscopy to monitor the health of the world's seas and oceans.

Remote sensing, initially from satellites as early as the 90s, but increasingly from unmanned aerial vehicles (UAVs), is used to monitor the health of coral reefs by detecting symbiotic algae and its chlorophyll byproduct with fluorescence peaks at 685 and 740 nm with pulsed laser fluorescence.

Another group of researchers studying ocean and coastal waterways has been developing models to anticipate intense phytoplankton blooms using irradiance spectroscopy. These harmful blooming events adversely affect ecosystems and human health as well. Using UAVs fitted with an Avantes dual channel spectroradiometry solution covering 360-1000nm the team was able to derive fine-resolution spectra data and obtain timely information on bloom magnitude, making spectral bloom monitoring during algal bloom season a possibility.

Avantes is at the forefront of environmental research

The Avantes family of spectroscopy solutions are trusted by environmental and climate researchers around the world for accurate, robust spectral measurements. With more than two decades' experience in supporting the unique needs of diverse industries and applications, Avantes is your trusted partner in meeting your measurement objectives. Our innovative designs and commitment to advancing the science of photonics means that Avantes spectrometers are built to handle the new and innovative uses researchers are finding for spectroscopy.

Resources

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