Funded PhD Project – Department of Physics – University of Warwick

Advanced photodetectors for water contamination monitoring

This collaborative PhD project combines photodetector development and testing with real-world applications in continuous monitoring of water quality. Academic supervision is split between the Surface Science and Elementary Particle Physics Groups at Warwick, and industry supervision is provided by Multisensor Systems.

For further information and to apply, please contact Gavin Bell gavin.bell@warwick.ac.uk and Physics Postgraduate Admissions. The project will suit candidates with a strong background in physics, physical chemistry or engineering. Full funding is available for UK students via the EPSRC Collaborative DLA scheme, covering fees and a UKRI-rate stipend for 3.5 years and a £5000 Research Training Support Grant.

Outline. Water quality is high in the public consciousness. Continuous monitoring water contamination, rather than a periodic sample-and-test approach, is increasingly important to both suppliers and users of water. Optical monitoring of water by fluorescence or absorption can provide vital information in real time [1]. This project will explore three complementary photodetector systems operating in the ultraviolet and visible range whose main application is the real-time monitoring of water contamination. These are: (1) a thumb-sized mini-spectrometer developed by Hamamatsu which provides full UV-Vis spectra using customised control electronics developed in Warwick, (2) unique *gap gaseous electron multiplier* (GGEM) sensors developed in Warwick from particle physics detector technology, which provide threshold detection at high sensitivity, and (3) low-cost UV-Vis photodiode sensor arrays. The student will be responsible for testing and developing these sensors, developing data reduction methods for real-time analysis, and quantitatively assessing their strengths and weaknesses.

Industry collaboration. The work will be carried out in collaboration with Multisensor Systems Ltd. whose “electronic nose” technology is complementary to optical monitoring. Multisensor Systems will provide co-supervision for the project, including guidance on substances of interest, the developing regulatory and commercial environment, and implementation and testing of real-time data analytics methods. The student will undertake regular visits to Multisensor Systems to work on sensor integration and perform comparative tests. Technical development work will be done with the help of the Electronic and Mechanical Workshops in Physics. We also collaborate with the Environmental Engineering department at Monash University in Australia; additional funding may be available to support a research visit to Australia.

Photocathode materials. One aspect of the project will be the fabrication of custom-made photocathodes for our GGEM devices. The wavelength range of sensitivity is defined by the work function, which can be tailored by surface coatings just a few nanometres thick [2]. We work with the Accelerator Science team at STFC Daresbury Laboratories on photocathode development. Extensive hands-on training and support in thin film growth and surface science will be provided along with a range of taught postgraduate modules tailored to the student’s needs.

[1] Ultraviolet absorption of contaminants in water, Sci. Rep. **11** 3682 (2021).
[2] Photocathode performance characterisation of ultra-thin MgO films on polycrystalline copper, J. Phys.: Conf. Ser. **2420** 012032 (2023).