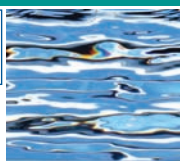


Nanotechnology for sustainable water purification

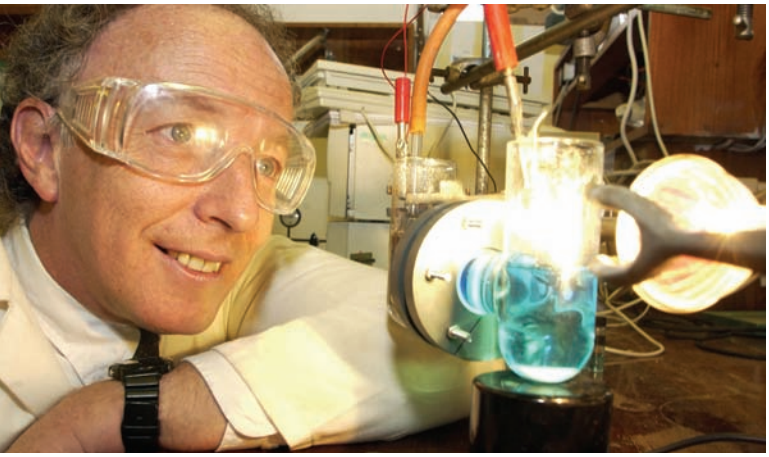
The University of Aberdeen and its partners are working to develop a new technology that uses sunlight to treat dirty water and create electricity simultaneously.

Key benefits

- purifies contaminated water
- sustained by light and able to generate electrical current
- more cost effective and environmentally friendly than existing technology
- can treat both chemical and biological contaminants

As the population increases, so does the pressure on water utilities companies to provide clean drinking water. In the last five years alone the global water supply industry has spent more than £57 billion on purification treatments. As the population is set to continue rising over the next 10 years, so is the cost of providing clean water.

In the treatments for endocrine disrupting chemicals (EDCs) alone, anticipated industry investments throughout the UK will be greater than £30-50 million over the next five years. Much of this money will ultimately be wasted as existing EDC treatments, based on activated carbons, ozone and UV processes, are cost intensive, have an unfavourable environmental impact, and what's more, are ineffective on some contaminants.



In order to address this need within the industry for a cost effective way to decontaminate water, scientists at the University of Aberdeen have been developing a new technology that uses a sunlight-powered catalyst to treat contaminated water. The photoelectrocatalyst is mounted into an electrochemical cell and, when it reacts to light, the catalyst interacts with any organic pollutants in the water, oxidising them across the catalyst's surface. Another by-product of this process is the recovery of charge in the cell, meaning that as well as purifying water, this technology also creates electricity.

The university's early laboratory trials were enough to attract both manufacturing and end-user partners and together they have formed a consortium. Bringing complementary expertise in commercialisation, research, development and manufacturing, these partners will ensure that the programme delivers a commercially viable technology via prototype fabrication. Due to run until 2008, the collaborative R&D project started in March 2005 with total costs of £1.2 million. The programme attracted a grant of £600,000 under the DTI's micro and nanotechnology manufacturing initiative – part of the government's Technology Programme.

Scotoil Services is leading the project, in partnership with the University of Aberdeen, Yorkshire Water and OpTIC Technium.

Objectives

The objective is to build a working prototype in order to demonstrate that the technology is commercially viable within the water supply industry. This will require close integration with manufacturing partners to ensure that the laboratory models are successfully scaled up, that the correct materials are selected and to consider issues such as position and orientation

of components. However, before the prototype can be built, the technology has to be tested and adapted to ensure it meets its end-users' needs. Can it oxidise the contaminants that their current systems cannot and will it fit into existing infrastructure?

Initial trials proved the cell to be robust and able to degrade a range of relevant pollutants. But by working with end-user partners, the consortium has been able to develop the tests and therefore the technology much further. With their input, laboratory tests can be created that replicate the contamination conditions within individual water treatment plants around the UK. This has led to research looking at the effects of competition between different pollutant species in the same body of water and what impact it would have on the cell.

To meet industrial infrastructure demands, the technology will have to work with flow devices and tanks and water transferred via them. So to inform the scale-up process and investigate dependencies on flow characteristics, the programme has developed a laboratory scale flow cell. This will also allow an assessment of the kinetic behaviour of the degradation and develop the technology to suit.

By coupling state-of-the-art biosensor detection systems developed at Aberdeen with the photoelectrocatalytic cell, the researchers are able to rapidly assess the effectiveness of the technology, and its compatibility with conventional biological water treatments and ultimately with drinking water standards.

Finally, there's the question of the electricity generated by the cell and the best use for it. Under laboratory conditions, the university has been able to recover currents of the order of micro amps. In a full-scale prototype, multiple cells may deliver sufficient current to drive pumps or other peripheral equipment. However, the primary focus of the commercialisation development is in the direction of water purification.

Solutions

By attracting the right partners and working closely with both manufacturers and end-users, the University of Aberdeen believes it can take the technology out of the laboratory and into the marketplace. The consortium is confident of meeting any remaining challenges and of completing a working prototype for the water industry within the timeframe of the programme. But this is just the start. As it is activated by light and has the potential to generate electrical current, the technology could be used in almost any country.

Results

The programme has already demonstrated proof of concept and if work goes to plan it could become a significant piece of technology.

"Everyone in the world wants clean drinking water and the situation at present is that the availability of a clean water supply across the world is actually decreasing," says Dr Donald Macphee of the University of Aberdeen's Department of Chemistry. "So any new technologies that can be put in place to address that will be very much in demand. If we do demonstrate functionality as we expect to then there are very big opportunities, not just for all of the partners involved but for the UK in general."

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Collaborative Research & Development

Collaborative Research & Development is one of two business support solutions within the Technology Programme, the other being Knowledge Transfer Networks (KTNs). Its primary objective is to enable the industry and research communities to work together in strategically important areas of science, engineering and technology in order to develop successful new products, processes and services. It also enables the latest thinking and understanding to flow between universities, other research centres and business.

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