

Bac2: the future?

We take a look at the Southampton-based start-up that hopes to bring down the cost of fuel cells

Because the only waste product from hydrogen fuel cells is water, politicians, from London's mayor Ken Livingstone to the new Conservative party leader, have been queuing up to support the technology. In July this year, during a visit to Southampton University, David Cameron took time to talk to a company whose products could make a substantial impact on the sector. Bac2, which is a member of the university's SETsquared Business Acceleration Centre, is the only UK company that is making composite bipolar plates – an important part of a fuel cell – and it is determined to drive down their production cost.

Fuel cell components have been dogged by problems of fragility and cost of manufacture, which Bac2's electrically conductive polymer – ElectroPhen – could solve. ElectroPhen is robust, cures at room temperature and can be economically produced in bulk. This makes it ideal for making the bi-polar plates and end plates that link individual fuel cells to produce fuel cell stacks.

Plastics are normally electrically insulating, but Bac2's base polymer – ElectroPhen – is different because conducting pathways are produced in the polymer as it cures. The resulting conductivity can be further increased by adding conductive fillers.

History

Bac2 was formed in 2002 by a polymer chemist, **Dr Graham Murray**, to develop conductive polymers on

a commercial scale. Murray, who is currently chief technology officer, had 20 years experience in the polymer industry when he founded the business with private and angel investor funding.

Mike Stannard joined as managing director in 2005 to expand commercial activities in the fuel cell market. Stannard has an entrepreneurial background: he launched the Southampton University spinout, **Offshore Hydrocarbon Mapping (OHM)** – a company he saw through two funding rounds to a £48m flotation on the Alternative Investment Market. He is also a major investor in Bac2.

There are many different types of fuel cell, but they all work in similar ways. They are a sort of cross between an engine and a battery in which hydrogen, or another fuel, is converted into electricity through an electrochemical reaction in a membrane electrode assembly (MEA). To obtain useful amounts of power MEAs are joined together to form a fuel cell stack. Within the stack, the individual cells are separated by bipolar, or separator, plates, which contain channels that direct the flow of the fuel gases (air and hydrogen) and remove the waste water while at the same time conducting the electricity generated. Plates make up 70% to 80% of the total weight (and 30% of the cost) in a stack, so producing them as cheaply as possible is essential if fuel cells are to be adopted in large numbers.

ElectroPhen is the most cost-effective solution for bipolar plate manufacture, Bac2 argues. Even so, no single product will suit all cells and the company is tailoring its polymer to suit a range of applications.

Key properties

If the company's aim were simply to drive down the cost of an individual fuel cell component its future might not be particularly bright. But the key properties of ElectroPhen: conductivity, availability in bulk, room temperature cure, low toxicity and suitability for recycling, make it ideal for applications beyond fuel cell plates. For example as:

■ *Electro Magnetic Interference (EMI) shielding*

EMI is a challenge as electronics products shrink in size and increasingly rely on plastic casings, both for design and weight reasons. Making plastic electrically conductive would improve EMI shielding. ElectroPhen has the potential to provide low cost, moulded shielding, says Bac2. It is also possible to inject ElectroPhen at room temperature into cavities with

irregular shapes, providing shielding where hot injection moulding, extrusion or compression moulding are not possible.

■ *Antistatic material*

Static electricity can be deadly in industries such as petrochemicals and mining. Increased regulation is forcing companies to adopt safer equipment, so demand for conductive materials is growing. Current approaches to avoid static charging on plastics have their drawbacks. External antistatic agents wear off while internal ones migrate to the surface and last for only a few months. ElectroPhen offers a permanent alternative to these treatments.

■ *Water Treatment*

Metals pollute the waste streams from many industrial processes. Electrochemical treatment to remove them or to recover valuable metals is a clean alternative to using chemicals to precipitate them from solution. But conventional carbon materials used in electrodes are expensive to manufacture and machine. ElectroPhen is an alternative, and composite carbon electrodes have already been used to electrochemically deposit copper from a waste stream.

Funding

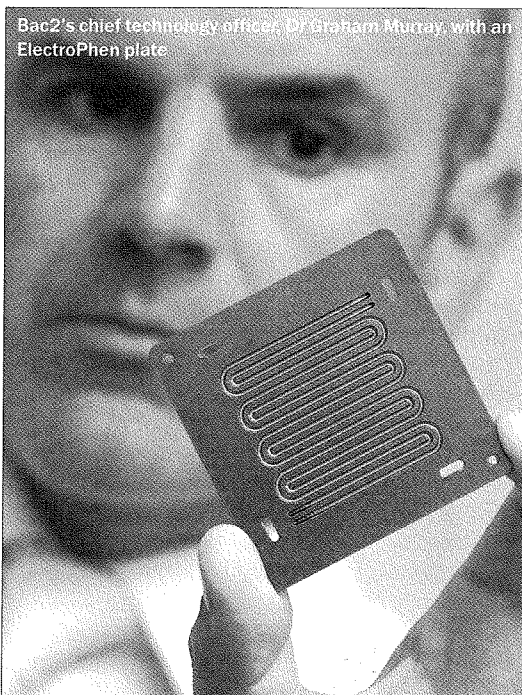
In April, the **DTI** awarded Bac2 funding of £240,000 to lead a six-member consortium that will optimise its ElectroPhen material for use in fuel cells. The following month it secured £500,000 of seed corn investment. The round was led by **London Seed Capital**, in conjunction with the **London Business Angel Network** and the newly raised **LBA EIS Tracker Fund III**. Further angel investors came to Bac2 through the **South East Capital Alliance (SECA)**.

Following the cash infusion, it strengthened its board with the addition of two new members. **James Lewis** – who co-founded **Oxford Semiconductor** in 1992 and formed start-up consultancy **Parallaxis** – was appointed chairman and head of sales and marketing, while investment banker **Michael Burrow** joined as a non-executive director. And in August, **EMI Central Research Laboratories'** veteran and **Scipher** founder **Dr Ashok Vaidya** agreed to act as company mentor.

For the moment fuel cells are little more than a niche product. But Bac2's managing director believes the future is very bright for the company. "The application of fuel cells within every day products, from MP3 players to lawn mowers as well as cars and computers, is increasing all the time," says Stannard.

His aim is to get ElectroPhen into as many of those products as possible.

► www.bac2.co.uk



Bac2's chief technology officer, Dr Graham Murray, with an ElectroPhen plate