Innovation Awards 2015

REWARDING EXCELLENCE

COVERED IN GLORY

This year's overall winner is ready to make a big impact on shipping costs

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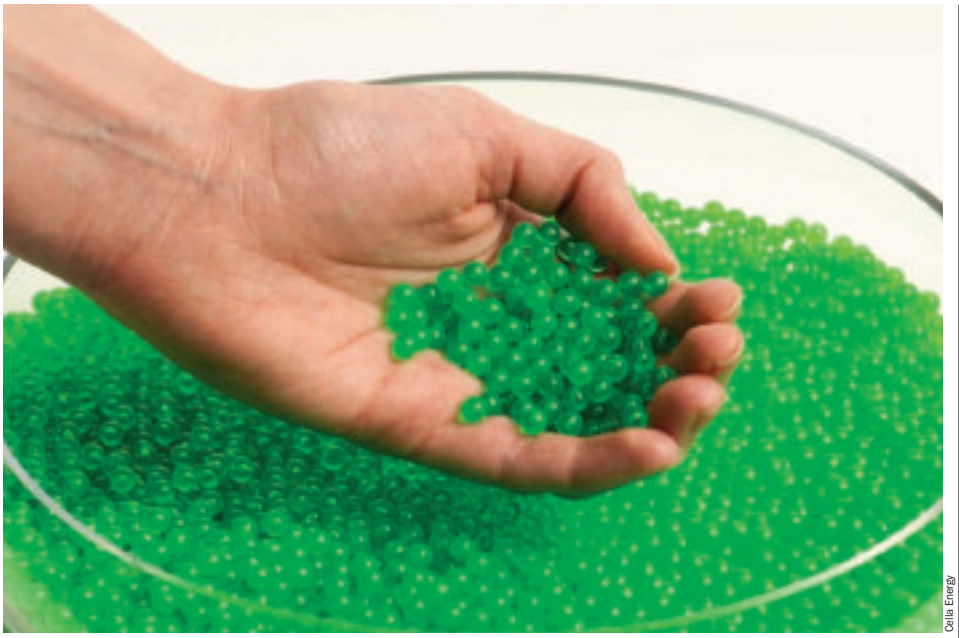
Cella Energy

Lots in store for hydrogen

Cella Energy has developed a way of storing and delivering hydrogen in pellet form, making it attractive for use in powering fuel cells

KAREN HARRIES-REES BRIGHTON, UK

UK-based Cella Energy has developed a solid hydrogen storage material which, when combined with a fuel cell, can deliver three times as much energy as a good lithium ion battery. The material uses a boron-based hydride mixed with polymer to create a plastic-like solid that is safe to handle, easy to process and rapidly releases large quantities of hydrogen when heated to over 100°C.

The technology delivers hydrogen at a price that is comparable with other forms of hydrogen when it is made in bulk. And when the system is chemically regenerated using renewable energy, it could offer a low-carbon alternative to fossil fuels.

The development came out of work into the use of nanotechnology to improve the performance of hydrogen storage materials that Stephen Bennington, managing director of Cella Energy, was doing at University College London (UCL) and the Rutherford Appleton Laboratory in the UK. Bennington chose to work with ammonia borane, which had come out of US Department of Energy-funded research into hydrogen storage. "The pre-cursor chemicals were cheap and readily available and material stored huge amounts of hydrogen and released it at sensible temperatures," he says.

However, ammonia borane had a couple of problems. For rapid hydrogen release it needed to be heated to 120-150°C but it melted at 100°C.

"The result would be a horrible foaming mess," explains Bennington.

The other problem was that it took 5-10 minutes for the hydrogen to be released once the material had been heated.

The group worked on solving these problems and the resulting product is a polymer-based composite material. Cella uses a freeze drying process to get the right micro- and nanostructure. The structure is important for the speed of release of the hydrogen and so that the hydrogen can get out without swelling the pellets.

"The important breakthrough is that it doesn't melt and it remains solid throughout the hydrogen release. But it's porous enough for the hydrogen to get out without damaging the structure," says Bennington.

Cella was spun out of the Rutherford Appleton Laboratory in 2011 with connections with UCL and Oxford University. The company has 20 staff and is based in the UK with a facility at the Kennedy Space Center in the US.

FINDING MARKETS

Bennington says when they first started he was surprised that no one wanted to buy the hydrogen storage material. Instead, the company turned its efforts to using the material to build solid-state gas generators. These create a stream of hydrogen to feed into a fuel cell and have attracted considerable interest, particularly from the aerospace industry, because they are light.

Innovate UK has funded a project to create a prototype for use in civilian drones. A third prototype is being test flown in October this year.

Cella has also recently started working with Israel Aerospace Industries, the world's largest exporter of small drones used for surveillance, to develop a system to be integrated into its *Bird Eye* 650 small unmanned aircraft system. Cella's system can extend the flight time of fixed wing drones from 4-5 hours to 12 hours.

It is also starting projects on multi-rotor drones. Currently these get 12-20 minutes flying time. "We think we can get over an hour flying time," says Bennington.

The company is also working with French aerospace company Safran to build larger devices of 2-20kW to be used in aircraft. Applications include powering galleys and toilets using a combined heat and power system.

Cella is also starting a five-year project to develop a pelletised form that can flow like a fluid. Cella is working on coating the pellets with a gas separation membrane, probably a polymer-based paint to filter the hydrogen, and on scaling up the production process.

Longer term projects are looking at automotive uses. These draw on some of the aerospace designs that Cella is developing with Safran and are being funded by Innovate UK. One application is as a back-up power supply to extend the range of an electric vehicle by an extra 100-150km. Another possible application is to reduce the particulates produced by diesel engines. ■

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STEPHEN BENNINGTON
Managing director, Cella Energy