It's a gas!

Microtechnology is at the heart of a hydrogen powered fuel cell for mobile phones. By **Graham Pitcher**.

The last few years have seen a growing concentration on the importance of power. The drivers for this interest are multiple. On the one hand, consumer electronics devices are getting smaller, which is bringing the need for batteries with a higher power density, and consumers want longer battery operating life, which is forcing semiconductor manufacturers to make more efficient devices. On the other hand, growing 'green' awareness is forcing power efficiency higher up the agenda.

This burgeoning market has been attracting interest from a range of companies over the recent past. But one of the leading semiconductor manufacturers is also taking a serious look at the sector – and it plans to use MEMS technology.

Addressing a recent investors and analysts meeting, Carlo Papa, executive vp of STMicroelectronics; industrial and multisegment sector business, said: "The shining star over the last two years has been MEMS. This has shown tremendous growth."

In fact, STMicroelectronics plans to deliver micro fuel cells to the market in 2009 and its recently announced collaboration with French public technological research organisation CEA is designed to underpin some of this work on miniaturised energy sources.

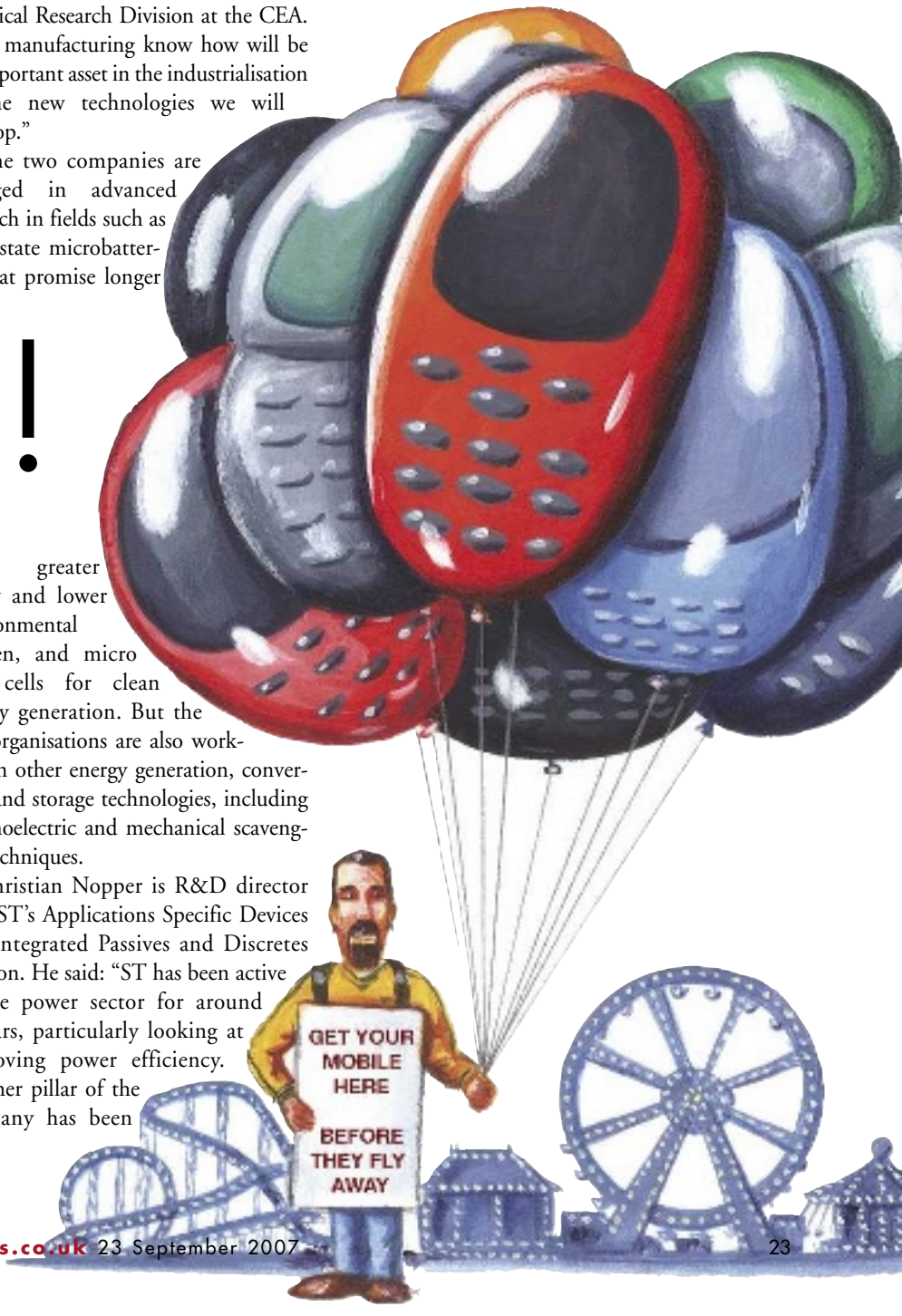
According to Papa, the proliferation of portable devices has created huge demand for energy sources. "But existing solutions leave room for improvements in terms of performance, operating life and environmental impact. We believe the complementary skills of ST and CEA will lead to the development of cost effective new technologies that will meet these challenges." "We have a long experience in working with ST, including successful previous collaborations in this field. We know the strength of its expertise, which was a factor in making us decide to set up a common lab between Tours and Grenoble", said Jean Therme, director of the Technological Research Division at the CEA. "ST's manufacturing know how will be an important asset in the industrialisation of the new technologies we will develop."

The two companies are engaged in advanced research in fields such as solid state microbatteries that promise longer life, greater safety and lower environmental burden, and micro fuel cells for clean energy generation. But the two organisations are also working on other energy generation, conversion and storage technologies, including thermoelectric and mechanical scavenging techniques.

Christian Nopper is R&D director with ST's Applications Specific Devices and Integrated Passives and Discretes division. He said: "ST has been active in the power sector for around 30years, particularly looking at improving power efficiency. Another pillar of the company has been our integrated passives technology. These two assets are allowing us to think about new energy sources based on our technology."

Nopper said two types of device were under development – micro fuel cells and microbatteries. "Both have a common background and technology," he added.

As part of this effort, will work with CEA Liten (Laboratory of Innovation for New Energy Technologies and Nanomaterials) on a four year program to develop new miniaturised technologies for energy solutions with a particular emphasis on



Henning Löhlein

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Christian Nopper, **STMicroelectronics**

powering mobile phones, laptops and other portable electronic products.

Nopper claimed the collaboration was a sensible move for ST. "We believe it's sensible to work with labs and research centres with the know how and knowledge of basic material behaviour."

Although the two organisations have only just announced their collaboration, work has been underway for three or four years. "We had the same approach," Nopper claimed, "and shared an interesting view of what the energy challenges and constraints would be. Because we have the same approach and understanding, we decided to work together."

ST's objective is to create a microfuel cell which gives 'instant on' operation for mobile phones and portable systems. "But laptops and portable systems have different power requirements," Nopper continued, "so the technologies will not be the same. People have been working for a long time on laptop power supplies, but their solutions are not compatible with the size and weight constraints of a mobile phone. We will be developing micro sources, rather than macro sources."

And it's power sources for mobile systems that are attracting ST and Nopper admits developing these is 'more challenging'. He noted that a laptop power source might be required to deliver from 10 to 20W, whilst mobile power sources would only need to deliver less than 5W. Igor Bambuin, manager of ST's New Energy Sources business unit, added: "Although there is no great difference between mobile phones and, for example, an iPod, mobile and laptop requirements are different, so the power source architectures will be different."

Two fuel sources are currently being researched: methanol and hydrogen. "We've spent a lot of time comparing the technologies and think that, for high power applications, methanol will be better. But for lower power requirements or for high density, then hydrogen will be the best choice," Nopper noted.

Bambuin continued: "Even if methanol solutions are further advanced than hydrogen, one thing we need to keep in mind is safety – methanol fuelled systems are more dangerous than those fuelled with hydrogen. Another significant issue is that methanol systems generate CO_2, whilst hydrogen systems generate water vapour."

ST is not involving itself in developing the hydrogen end of the fuel cell because other companies are working on that. "Our first goal is to develop a fuel cell for mobile phones," Bambuin continued. "We think there are two major points – technical maturity and regulation. We expect to ramp the product in 2009 and believe the regulatory issues to be finalised by then." One of the key issues here will be whether or not fuel cell powered devices will be allowed on aircraft.

The first products will be something that can be attached to a phone, for example, Bambuin claimed. "But this will be an intermediate step as we are looking to develop technology that can be integrated inside a device. And we have chosen the hydrogen route because we believe that will allow better integration. This step would be more difficult with methanol as its power density is lower."

The microfuel cell will have two parts: a cartridge containing NaBH4 as the hydrogen source; and the fuel cell core. The core – or die – comprises a cathode, electrolyte and anode. Hydrogen enters from one side and mixes with oxygen in the air, reacting over a catalyst to generate electricity. "We want this system to be passive," said Nopper, "and it will not use electronic or mechanical parts."

An important part of the micro fuel cell is the membrane and this is being developed by organisations such as CEA. "We're using existing membranes to get a reference, but we will need to fine tune them in order to get a smaller surface," Nopper noted.

Figure 1: Micro fuel cell core unit