Portable device storage

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The new report “Batteries, Supercapacitors, Alternative Storage for Portable Devices 2009-2019” is directed towards those developing, marketing and using small electronic and electrical devices, particularly those that are self-sufficient. It finds that extrapolation of the past gives a grossly misleading view of the future because radically different components are arriving such as transparent and tightly rollable versions and ones with electronic and electrical components and circuits printed above and below. That leads to completely different markets including biodegradable, stretchable and disposable electronics replacing non electronic products. For example at the recent IDTechEx event Printed Electronics Asia in Tokyo, a working electronic circuit was shown stretched over an egg without breaking it. We can anticipate moving beyond the e-reader and ultra low cost laptop to e-labels, e-posters e-packaging and ubiquitous use of disposable electronic medical testers, drug delivery patches and self-adjusting use-by dates, for example, as the challenges of affordable, appropriate energy capture and storage are overcome. That means markets that rise from billions to hundreds of billions of units yearly.

New design rules

The advent of the “missing” passive component, the memristor, in 2008 and thin film, flexible supercabatteries in 2009 underlines the need for new design rules for the new electronics. The traditional approach of the electronic designer using discrete components ,with little interest in how they are made, is breaking down because they are increasingly made as one part. Further, the distinction between electronics and electrical engineering is breaking down. A printed organic light emitting diode device can be a light or a television screen. Formerly, someone involved in lighting used to have little in common with someone designing batteries or radio. Someone designing an electronic product would have little interest in how each component was made. This is no longer true in new world of self-sufficient devices such as wireless sensor nodes and e-books that provide their own energy. Now we plan windows and wallpaper that are both solar cells and television forcing us into an integrated approach.

You do not pick up a box full of components to make these things. The new electronics and electrics calls for a very close coordination between materials scientists, printers, device physicists, electronic designers and marketers. An important part of this is local production and management of electricity in the small

device be it a mobile phone or a disposable medical tester, smart packaging, e-labels or laptops. That is the subject of this report.

Batteries, capacitors and alternatives are increasingly used in coordination with energy harvesting. This is the provision of electricity in autonomous devices by converting ambient energy. That includes technologies such as thermoelectrics , piezoelectrics, electrodynamics and photovoltaics and, in microelectromechanical systems MEMS, capacitive (electrostatic) harvesting.

Needs

There is a broad range of energy storage levels needed in small electronic and electric devices. Most energy harvesting still needs storage because the source of energy is rarely available at the right level when needed. That means batteries in the main but with some use of capacitors on their own in, for example, photovoltaically charged wristwatches, remotely reprogrammable price labels and some bicycle dynamos. Power can be beamed to small electronic devices, as with radio frequency identification RFID, and here again capacitors may be used with no battery. However, most so-called active RFID ie where the tag is powered, employs batteries in the device. This then, is a story mainly about batteries but capacitors have a place, including on the batteries to boost performance when needed, but there are many other options coming along. All this is covered in this report.

Work needed

It is clear that there will never be a winner between rechargeable and single use batteries because their functions are complementary and present and future uses demand both.

In the last ten years, improvements in single use batteries have been more impressive than those with rechargeable batteries, as anyone wrestling with dead laptops and mobile phones can testify. However, in general, batteries have not kept up with the 100% to 1000% improvement in electronic and photovoltaic component parameters.

The battery of an analogue transceiver in the 1920s occupied 5% of the device volume. Today, the batteries in a Crossbow Mica mote for Wireless Sensor Networks WSN represent 90% of the device volume and weight. Alkaline cells still lose 4% of their capacity every year and most batteries last well under ten years, yet the new electronics of wireless sensor mesh networks etc demands 20 year life. In most of the planned new applications, it is not practicable to visit all the nodes to change batteries.

Even battery shelf life remains limited. We all know how the only problem we have with our wristwatch, car keys, alarm clock and so on is changing the battery and the problem when it does not work. Expensive silver coin cell batteries are used in key finders yet they still have to be replaced every six months or so. Many sensor nodes need new batteries in much shorter times. The exponentially growing number of battery driven products we have around us means that there will be a tipping point where simply changing batteries will form an intolerable percentage of our time. Already, the 30 billion coin cells made every year are creating increasingly

intolerable pollution, safety and service problems. Clearly there is work to be done.

Where supercapacitors fit in

In the marketplace, the initial thrust with supercapacitors is to make new things possible where properties intermediate between those of a capacitor and those of a battery are needed. Then there has been some replacement of capacitors where this results in improved performance as with some flash cameras. Finally, we are seeing the dream of replacing some batteries, even ones delivering considerable amounts of power, though this is still very much work in progress. Of course, there is more to it than this. In many energy harvesting applications, light weight is important. After all, most of them are concerned with mobile electrical and electronic devices.

Fuel cells can have the highest energy density of all combined with the lowest power density, but they usually need to operate at constant load and their problems of cost, reliability and sometimes safety remain unresolved.

A totally new world

As the traditional parameters of small batteries and capacitors are painfully and slowly improved, some completely different improvements are proving exciting because they can open up amazing new markets. These include transparent, edible, stretchable, woven, stitchable, implantable, biodegradable and wide area versions more suited to the world of ubiquitous electronics that is arriving. A billboard and even a building becomes an electronic device. As wall decoration, windows, apparel, books, posters, consumer goods, pharmaceutical packaging , the skin of an aircraft and the inside of a car and much more become electronic and local harvesting of power becomes commonplace, these are the products we need.

For more attend “Printed Electronics USA” San Jose December 2-3
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