Power on the go

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Mobile devices are becoming more and more intelligent – allowing users to watch movies on a mobile phone or laptop, or navigate with a PDA – but at the same time they require increasing amounts of power. To prevent the PC screen from suddenly going black, or the music from being interrupted, Fraunhofer researchers are working on micro power engineering solutions to provide the mobile power needed by modern communications devices. The latest examples of their work can be seen at the Hanover Trade Fair.

"Please save your data, the computer is shutting down" – for anyone who works while traveling on business, laboring over a new spreadsheet or writing an important document while sitting on the train, the threat of data loss can be frustrating. Each new generation of portable electronic devices incorporates new data acquisition and processing capabilities, and transfer speeds have meanwhile become fast enough to stream movies or soccer matches. But this comes at a price in terms of operating time – depending on the quality of the battery, a laptop, for example, shuts off after two to three hours if no power outlet is available. If used frequently, UMTS mobile phones must be charged at least once daily, while MP3 players with rechargeable batteries last just a few hours, depending on the quality of the battery.

Under the leadership of the Fraunhofer Institute for Solar Energy Systems ISE, scientists from various institutes are working on technologies that will make it possible to achieve greater power densities and, when combined with batteries in hybrid energy systems, extend operating times. At the Hanover Trade Fair, the researchers will be

displaying new energy storage technologies, micro-fuel cells, and information on the opportunities offered by "energy harvesting," or drawing power from multiple energy sources available in the environment of the device.

For the researchers, employing micro fuel cells as chemical power converters represents a focal area in supplying power for mobile devices. For example, the flat micro fuel cells from the Fraunhofer Institute for Reliability and Microintegration IZM are made of polymer and metallic films and based on wafer level- and film technologies. Three individual cells connected in series achieve an aggregate voltage of around 1.5 V, which is sufficient to replace conventional button cells, for instance. The ISE, too, has already presented several micro fuel cell systems with power ratings ranging from a few mW up to several hundred watts. The researchers are exploring various ways of producing hydrogen: one method utilizes chemical hydrides such as sodium borohydride or borazan to produce hydrogen by introducing heat or water, or by employing catalysts. Another involves converting liquid methanol to hydrogen in direct methanol fuel cells (DMFC). A further possibility is offered by the use of micro-reformers, where hydrogen is produced from hydrocarbons such as ethanol, diesel fuel or liquefied petroleum gas.

The concept of energy harvesting refers to using light, heat or motion to generate energy. For example, the Fraunhofer Institute for Physical Measurement Techniques IPM employs thermoelectrics: energy is generated by a heat flow source such as the user's wrist. Prominent clock makers use this technology to power watches. Micro-integrated thermo-electric converters can also be used to cool electronic components.

The Fraunhofer Institute for Integrated Circuits IIS in Erlangen has developed an inductive charging process for smart cards that involves using electromagnetic fields to charge the chip, similar to an electric

toothbrush charging station. Design plays an important role in many devices; traditionally, devices such as laptops or camcorders have had to be designed around the power supply, in which case the rechargeable battery takes up considerable space. Researchers at the Fraunhofer Institute for Silicon Technology ISIT in Itzehoe have developed a flexible, bendable battery that gives designers more freedom in determining the shape of the device housing – this would allow laptops or PDAs, for example, to be made even smaller. Solar cell technology also lends itself to use in modern mobile devices, as demonstrated by the solar-powered mobile phone introduced by researchers at the ISE, which achieves a module efficiency rate of 20 percent using device-integrated, high-efficiency solar cells. This technology will enable unlimited standby times, meaning the phone can always stay powered on. A solar-powered PDA would also be capable of operating self-sufficiently.

Future efforts to optimize power supply systems for mobile devices will increasingly involve the use of multiple power generation technologies with an electric buffer store. In order to achieve maximum power utilization with the highest degree of efficiency, a system of intelligent power management is needed. The goal is to link the energy delivered by batteries, solar cells, thermoelectrics or fuel cells in a device. With this kind of system, a laptop could switch to fuel cells when the battery is depleted, and this in turn would be continuously recharged by the solar cells whenever light conditions were favorable. Power management ensures that MP3 players, mobile phones and notebooks always have an optimal power supply.

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