A new type of rechargeable battery that could store five to ten times more energy than current batteries is under investigation at the University of St Andrews with funding from the EPSRC.

The new batteries contain cheaper materials, and could store more energy, than current rechargeable lithium batteries. The design replaces a chemical component in today’s rechargeables with one that uses oxygen drawn from the air during discharge.

**IMPACT ON INDUSTRY AND TRANSPORT**

- This work could lead to batteries that store more energy or smaller, lighter batteries, paving the way for a new generation of batteries for mobile phones, MP3 players and laptops.
- The design could avoid the problems of intermittent supply for renewable energies, such as solar energy, by providing a constant electrical output; the batteries would discharge at nightfall and recharge when the sun shines.
- Low cost and higher energy storage batteries offer great promise for improving electric and plug-in hybrid vehicles.

**Using oxygen from the air**

Rechargeable lithium batteries contain positive electrodes made of lithium cobalt oxide. When they are charging, lithium is removed from the electrode; when they are discharging lithium is replaced. This means that their capacity to store energy is limited by the lithium cobalt oxide electrode. The St Andrews Air (STAIR) cell design replaces this electrode with one made of cheaper porous carbon. This battery relies on using oxygen in the air rather than carrying the necessary chemicals around inside the battery.

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The oxygen is drawn in through a surface of the battery exposed to air and reacts within the pores of the carbon with Li+ ions from the electrolyte and electrons from the external circuit to discharge the battery. The design exploits the discovery, made at the University of St Andrews, that the carbon component’s interaction with air can be repeated, creating a cycle of charge and discharge.

**Encouraging results so far**

The new batteries have a higher energy density than conventional rechargeables. “This means that they can store more energy per unit size and weight, so you can produce a same weight battery that stores more energy or a smaller, lighter battery that stores the same amount of energy,” explains team leader Professor Peter Bruce. “Our target is to get a five to ten fold increase in storage capacity, which is beyond the horizon of current lithium batteries,” he continues. “Our results so far are very encouraging and have far exceeded our expectations.”

The research project, which is due to end in the summer of 2011, is focused on understanding and improving the chemical reaction in the battery. The team is also working towards making a STAIR cell prototype for small applications, such as mobile phones.

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UP TO TEN TIMES MORE ENERGY COULD BE STORED IN NEW RECHARGEABLE BATTERY