

# Alternative to traditional batteries moves a step closer to reality after exciting progress in supercapacitor technology

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Lithium-ion batteries could be under threat after the development of polymer materials by the Universities of Surrey and Bristol, along with Superdielectrics Ltd, that could challenge the dominance of these traditional batteries.

Only one year ago, the partners announced scientific results for novel

polymer materials that have dielectric properties 1,000 to 10,000 times greater than existing electrolytes (electrical conductors). These stunning scientific findings have now been converted into 'device' scale technical demonstrations.

Researchers from the universities achieved practical capacitance values of up to 4F/cm<sup>2</sup> on smooth low-cost metal foil electrodes. Existing supercapacitors on the market typically reach 0.3F/cm<sup>2</sup> depending upon complex extended surface electrodes.

More significantly, the researchers managed to achieve results of 11-20F/cm<sup>2</sup> when the polymers were used with specially treated stainless-steel electrodes – the details of which are being kept private pending a patent application.

If these values of capacitance can be achieved in production, it could potentially see supercapacitors achieving energy densities of up to 180Wh/kg—greater than lithium ion batteries.

Supercapacitors store energy using electrodes and electrolytes and both charge and deliver energy quickly – conventional batteries perform the same task in a much slower, more sustained way. Supercapacitors have the ability to charge and discharge rapidly over very large numbers of cycles. However, because existing supercapacitors have poor energy density per kilogramme (currently around one twentieth of existing battery technology), they have been unable to compete with conventional battery energy storage. Even with this restriction, supercapacitor buses are already being used in China, but the current technology means that they need to stop to be recharged frequently (i.e. at almost every bus-stop).

The team of scientists have been able to test the new materials in two ways:

- By using small single layer cells charged to 1.5 volts for two to five minutes and then run demonstration devices, including a small fan.
- By using a three-cell series stack that is able to be rapidly charged to five volts and operate an LED.

The University of Bristol is going much further by producing a complex series-parallel cell structure in which both the total capacitance and operating voltage can be separately controlled.

Based on these impressive results, Superdielectrics Ltd, the company behind this technology, is now looking to build a research and low volume production centre. If successful in production, the material could not only be used as a battery for future mobile devices, but could also be used in refuelling stations for electric cars.

Dr. Brendan Howlin, Senior Lecturer in Computational Chemistry at the University of Surrey, said: "These results are extremely exciting and it is hard to believe that we have come so far in such a short time. We could be at the start of a new chapter in the technology of low cost [electrical energy storage](#) that could shape the future of industry and society for many years to come."

Dr. Donald Highgate, Director of Research for Superdielectrics Ltd and alumnus of the University of Surrey, said: "These exciting results are of particular satisfaction to me because they build upon my work in hydrophilic polymers that has been a major part of my professional life; beginning in the later 1970s with extended wear soft contact lenses, and leading in the period 1990 to 2009, to fuel cells and electrolyzers of exceptional efficiency.

"The present work, if it can be translated into production, promises to make rapid charging possible for electric vehicles, as well as offering a

much-needed low cost method of storing the transient output from [renewable energy systems](#). Wind, wave and solar energy is available but it is intermittent and, without storage, cannot be relied upon to meet our energy needs. This new work would transform the energy system which underpins our entire way of life – it is the necessary development before we and our children can have a genuinely sustainable, environmentally safe energy supply."

Dr. Ian Hamerton, Reader in Polymers and Composite Materials from the Department of Aerospace Engineering at the University of Bristol, commented: "Following the unveiling of the preliminary results at the first press conference just 14 months ago, the team has worked hard to increase the storage capability of these innovative materials still further. Our foremost challenge is now to translate these scientific findings into robust engineered devices and unlock their revolutionary potential."

Provided by University of Surrey

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