

Cite this: *J. Mater. Chem.*, 2011, **21**, 9810www.rsc.org/materials

EDITORIAL

Advanced materials for lithium batteries

DOI: 10.1039/c1jm90082j

The importance of clean and efficient energy storage has grown tremendously in the past decade primarily due to the concerns of global warming, diminishing fossil fuel reserves, energy security, and increasing consumer demand for portable electronic devices. Without improved energy storage systems, the implementation of efficient renewable energy technologies would be limited; alternatives to our current course of petroleum consumption and attendant urban pollution will be greatly restricted; and the scope and everyday use of our favourite mobile devices would be narrowed.

The performance of energy storage technologies is crucially dependant on the properties and characterisation of their component materials. Indeed, innovative materials chemistry lies at the centre of advances that have already been made in the energy storage field, an excellent example being the rechargeable lithium battery, which has been instrumental in advancing the revolution in portable electronics (phones, laptops, mp3 players). The superior energy density of rechargeable lithium batteries, compared with other conventional batteries, has made them the dominant power source for these devices.

In the future, the need to cut CO₂ emissions from road transport will require new hybrid or electric vehicles with light, safe and inexpensive batteries, whereas the intermittency of renewable energy sources (such as solar and wind power) will require large-scale energy storage. We will therefore see different types of lithium batteries for a diverse range of applications, *e.g.*, low power and high capacity for portable electronics; high power and capacity for electric vehicles and plug-in hybrid vehicles; and inexpensive high energy density for load levelling for renewable sources.

The last decade has witnessed many significant developments in advanced

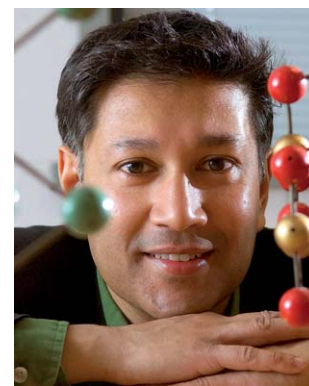
batteries, and many changes in direction in energy storage concepts. It has become increasingly clear that the next generation of lithium batteries depends critically on new materials, new approaches and greater understanding.

This themed issue of *Journal of Materials Chemistry* is therefore a timely opportunity to highlight some of the exciting recent advances in research on lithium battery materials by renowned international authors, covering major themes in this rapidly moving field. Although general topics will be mentioned, it is beyond the scope of this editorial to give an exhaustive survey of all the excellent reviews and papers in this issue. Rather, this editorial introduces the range of studies on lithium batteries to illustrate both the breadth of high quality work and the important role that fundamental research plays in the development of clean energy technologies.

A rich variety of materials chemistry is addressed in this issue, ranging from synthesis routes, nanostructured materials and electrochemical properties to surface modification, interface effects and particle morphologies. For instance, contemporary work on materials for positive electrodes (“cathodes”) is illustrated by studies of phosphate nanostructures and morphologies, silicate polymorphs, mixed-metal layered oxides, and fluoride nanocomposites.

Different features of negative electrode (“anode”) materials include articles on silicon-based nanowires, titania nanostructures, metal nitrides and zinc-based spinel oxides. Recent advances in developing electrolytes are illustrated by work on nanoporous electrolytes, interface chemistry and organic ionic plastic crystal materials. Lastly, topical issues on new concepts include studies on the lithium-air battery, conversion reactions and 3D microbatteries.

As Guest Editors, we would like to thank all the authors for their efforts in submitting a wide variety of high-quality peer-reviewed articles that advance state-of-the-art research. We are also grateful to the editorial and production staff at the RSC for their superb assistance. Finally, we hope that this timely themed issue will provide a valuable reference and perspective for the research community working in this exciting field.

**M. Saiful Islam**

University of Bath, UK,
m.s.islam@bath.ac.uk

**Linda F. Nazar**

University of Waterloo, Canada,
lfnazar@uwaterloo.ca