Graphene-based functional materials for energy storage devices

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Highlight statement: Graphene-based functional materials have been successfully developed as electrode materials for electrochemical energy storage devices. These include lithium-ion batteries, lithium-sulfur batteries, lithium-air batteries and sodium-ion batteries.

Global warming has induced the urgent adoption of electric vehicles and renewable energies. This will bring immense social and environmental benefits, including reduced CO_2 emissions, increased energy independence and energy security, and improved efficiency of transport. In this talk, I will report the development of graphene-based functional materials for lithium-ion batteries, lithium-sulfur batteries, lithium-air batteries and sodium-ion batteries.
Graphene nanosheets, tin-graphene and silicon-graphene nanocomposites have been prepared by various techniques. When applied as anode materials in lithium-ion batteries, they demonstrated enhanced electrochemical performances.[1]

Lithium-air battery is one of the most promising systems for meeting today's stringent requirements as the power source for electric vehicles. The theoretical specific energy of the Li-O_2 battery is 3,505 Wh kg^{-1}, which is almost ten times higher than that of Li-ion batteries (387 Wh kg^{-1}). Porous graphene with different pore size architectures were synthesized as cathode catalysts for lithium-air batteries. Porous graphene exhibited significantly higher discharge capacities than that of non-porous graphene. Moreover, the Ru nanocrystal decorated porous graphene exhibited an excellent catalytic activity with a high reversible capacity, low charge/discharge over-potential, and long cycle life.[2]
Sodium-ion batteries are being considered as a promising system for stationary energy storage and conversion, owing to natural abundance of sodium. Several graphene-based 2D electrode materials were synthesized as either cathode materials or anode materials for lithium-ion batteries and sodium ion batteries.[3-5]

References

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Short biography– Guoxiu Wang

Professor Guoxiu Wang is the Director of the Centre for Clean Energy Technology and a Distinguished Professor at University of Technology Sydney (UTS), Australia. He currently holds an ARC Professorial Future Fellowship. Professor Wang is an expert in materials chemistry, electrochemistry, energy storage and conversion, and battery technologies. His research interests include lithium-ion batteries, lithium-air batteries, sodium-ion batteries, lithium-sulfur batteries, supercapacitors, hydrogen storage materials, fuel-cells, graphene, and chemical functionalisation of graphene. Professor Wang has published more than 360 refereed journal papers with an h-index of 60. His publications have attracted over 13,000 citations (Web of Science).