ALTA 2022 26
20-27 May | Perth, Australia | Online

POTENTIAL FUTURE GAME-CHANGERS IN BATTERY TECHNOLOGY

By

Guoxiu Wang

University of Technology Sydney, Australia

Presenter and Corresponding Author

Guoxiu Wang

ABSTRACT

Batteries have been developed to power a diverse range of applications. Development of the Li-ion battery, for example, was revolutionary for portable electronics and mobile communication. The demand for batteries is set to explode with the emergence of the internet of things, home and grid storage solutions for electricity, and increasing pressure for more widespread use of electric vehicles. In this talk, I will report the development of advanced rechargeable batteries for grid-scale renewable energy storage and electrification of road transport.

Lithium-air battery is one of the most advanced 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. 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. Furthermore, we rationally designed and synthesized reagents such as modified tetrathiafulvalene (TTF) and ionic liquid as electrolyte additives to boost the performances of Li-O_2 batteries. Meanwhile, the development of sodium-air batteries will also be presented.

Lithium metal anodes enable the development of high energy lithium metal batteries. However, the practical deployment of lithium metal batteries has been hindered by the growth of lithium dendrites. We have studied temperature dependent nucleation and growth of dendrite free lithium metal anodes, deep eutectic solvent-based polymer electrolyte for safe and long-life lithium metal anodes, and immunizing lithium metal anodes against dendrite growth using protein molecules to achieve high energy batteries.

Sodium-ion batteries are being considered as a promising system for large-scale stationary energy storage and conversion, owing to natural abundance of sodium. Several novel electrode materials and electrolytes were synthesized for sodium-ion batteries and room-temperature sodium-sulfur batteries.

Keywords): Lithium-air batteries; High-energy lithium metal batteries; Solid-ion batteries; Room-temperature sodium-sulfur batteries.