

# Flexible and Stretchable Li-ion Batteries Based on Polyethylene Oxide-Graphene Oxide Electrolyte

## Research Themes

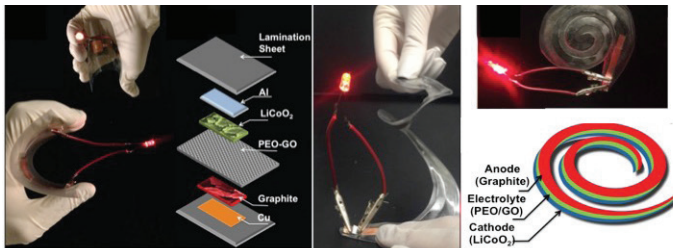
The strong demand for portable, ultra-thin, lightweight, flexible and stretchable devices, raises the need for new material and design concepts in battery technology that offer multi-functionality such as simultaneous electrochemical and mechanical functions. A key imperative in the development of the all-solid-state lithium ion batteries (LIBs) is the replacement of the traditional organic liquid electrolyte with high performance solid electrolyte. Flexible and stretchable Li ion batteries are developed, based on solid nanocomposite polymer electrolyte (1% graphene oxide nanosheets in polyethylene oxide host), exhibiting capacities higher than 0.1 mAh cm<sup>-2</sup> and excellent cycling stability over 100 charge/discharge cycles. Improvement in internal impedance of the battery is observed with the addition of 1% graphene oxide nanosheets to the polymer electrolyte. The energy density of the fabricated LIB is measured to be 4.8 mWh cm<sup>-3</sup> at room temperature. The laminated LIB exhibits robust mechanical flexibility, good voltage retention over high bending and stretching cycles (i.e. over 6000 cycles) and good electrochemical performance in different configurations.

## Recent Accomplishments

- Novel flexible and spiral LIBs are developed based on a solid polymer nanocomposite electrolyte that offers enhanced safety, flexibility and stability
- High performances: high operational voltage (2V-4.5V) and good capacity (0.13 mAh/cm<sup>2</sup>) recorded for the flexible battery prototypes and high energy density (4.86 mWh/cm<sup>3</sup>)
- The spiral LIB exhibits a robust mechanical stretchability with voltage retention of 88% after 9000 stretching cycle

## Issues

- Enhance solid polymer electrolyte properties with graphene oxide fillers
- Develop flexible and spiral Li ion battery with good performance and robust mechanical properties
- Enhance the encapsulation and protection of the battery from the external environment
- Enhance the charge-discharge performance and the battery life to handle high cycles number



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