

## Capacitive performance of graphene-based asymmetric supercapacitor

### ABSTRACT

A two-electrode asymmetric supercapacitor with positive and negative electrodes was developed. The positive electrode was composed of reduced graphene oxide/zinc oxide/cobalt oxide nanostructures (RZCo) that were prepared using a one-pot hydrothermal process. Meanwhile, polypyrrole/reduced graphene oxide (PyR) was electrodeposited on a graphite sheet as the negative electrode. These electrodes were separated by a 1.0 M Na<sub>2</sub>SO<sub>4</sub> filter membrane. The synergistic effect between the positive and negative electrode materials widened the potential window to 1.6 V, thus contributing a high energy density of 41.8 Wh/kg at 2 mV/s, which was better than that of the KEMET commercial supercapacitor (17.7 Wh/kg). At room temperature (30 °C), the RZCo//PyR asymmetric supercapacitor exhibited a retention of 87% after 800 cycles compared to a retention of only 49% at 0 °C. Although the asymmetric supercapacitor retained 86% of its original capacitance at 60 °C, it possessed a lower specific capacitance than the asymmetric supercapacitor measured at room temperature. The RZCo//PyR asymmetric supercapacitor had a larger specific capacitance and smaller IR drop (0.09 V) than the KEMET commercial supercapacitor, which has a huge IR drop (0.22 V), providing a specific capacitance of 77.7 F/g.

**Keyword:** Asymmetric supercapacitor; Cobalt oxide; Graphene; Polypyrrole zinc oxide