Development of MoS_2/rGO heterostructures for commercial coin cells

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Two-dimensional nanomaterials are premier candidates for electrochemical energy storage due to their high surface area and synergistic properties, as demonstrated by the 2D-2D heterostructure of MoS_2 and reduced graphene oxide (rGO) explored in this study. The flower-like morphology of the synthesized MoS_2, combined with the sheet-like morphology of rGO developed via a modified Hummer's method, increases interlayer spacing and prevents layer restacking of MoS_2, thereby facilitating superior ion transport through the van der Waals gaps. While standalone MoS_2 and rGO exhibit specific capacitances of 135 F/g and 57 F/g respectively, the optimized heterostructure (M/G-2) grown via a facile hydrothermal route achieves a superior three-electrode performance of 271.2 F/g within a potential window of -0.2 to 0.6V. Practical evaluation in a symmetric Swagelok cell using carbon cloth current collectors yielded a specific capacitance of 64 F/g, an energy density of 5.6 Wh/kg, and a power density of 394 W/kg, with a high cycling stability of 94.3% after 1000 charge-discharge cycles. Commercial utility of the device will be tested by fabricating symmetric coin cells using Al foil as current collectors. And real-world demonstrations will be validated by powering LEDs. Thus, stable, high performance electrodes for next-generation energy storage can be developed by combining MoS_2 and rGO.

References

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Figures

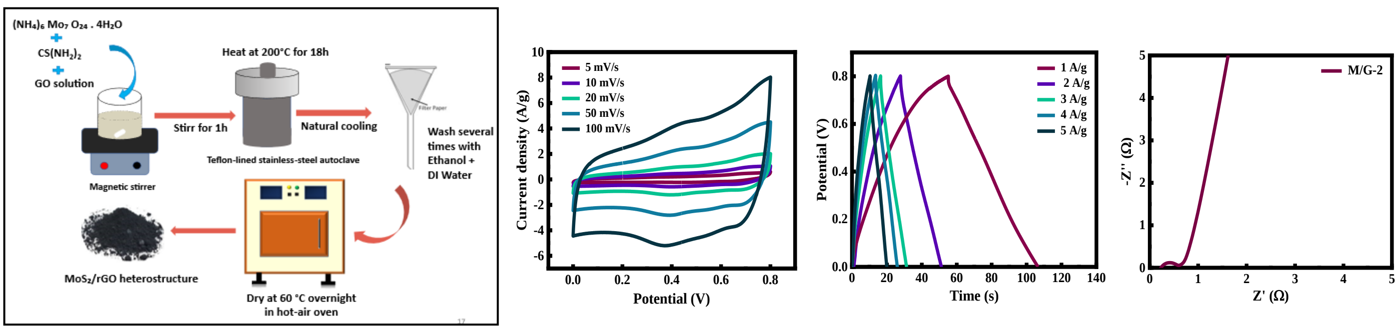

Fig. 1) Schematic of the synthesis route of MoS_2/rGO heterostructures 2) CV, GCD and EIS of symmetric devices using heterostructure M/G-2 in carbon cloth current collector.