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Large-Area Reduced Graphene Oxide Composite Films for Flexible Asymmetric Sandwich and Microsized Supercapacitors

Abstract
Asymmetric supercapacitors have attracted tremendous attention in energy storage devices due to their enhanced energy density. The development of asymmetric supercapacitor matching with diverse and flexible electronic devices depends mainly on the preparation of flexible components and the design of various configurations. Graphene and its derivatives are typical 2D materials and can serve as the building blocks to construct freestanding macroscopic graphene with porous structures, high electrical conductivity and excellent mechanical flexibility. Herein, a spontaneously reducing/assembling strategy in alkaline condition is developed to fabricate large-area reduced graphene oxide (RGO) and RGO-metal oxide/hydroxide composite films or microsized structures. The obtained pure RGO and RGO/Mn_3O_4 composite films possessing porous structure and superior mechanical property can directly serve as the electrodes of flexible asymmetric sandwish supercapacitors. Furthermore, the interdigital RGO and RGO/Mn_3O_4 patterns are also assembled via a selectively reducing/assembling process to achieve the asymmetric microsized supercapacitors. These asymmetric supercapacitors with different configurations exhibit excellent electrochemical performance and flexibility. Such reducing and assembling strategy provides a route to achieve large-area RGO-based films and microsized structures for the applications in the various fields such as energy storage and photocatalysis.

References

[1] X. Wang, Niu Z.*, et al. Adv. Funct. Mater. 2018,28,1707247

Figures

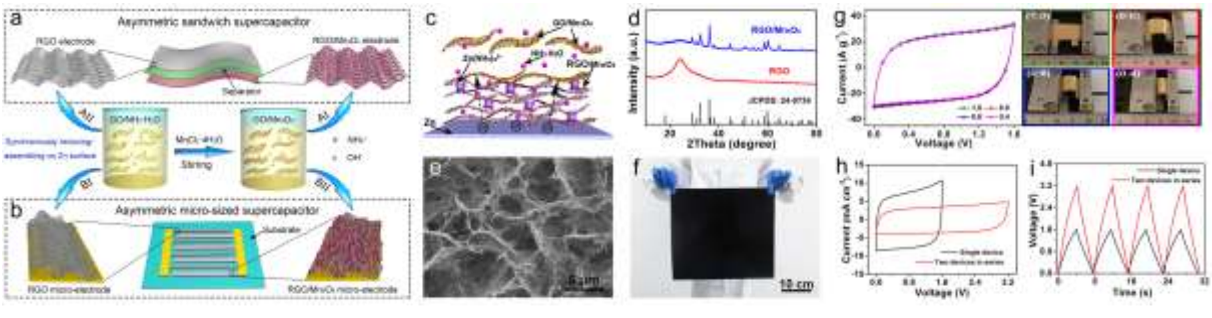

Figure 1: Schematic illustrating the synchronously reducing/assembling strategy in an alkaline solution to prepare the RGO and RGO/Mn_3O_4 electrodes of a) asymmetric sandwich and b) microsized supercapacitors. c) Schematic mechanism of synchronously reducing and assembling RGO/Mn_3O_4 composite film in $NH_3 \cdot H_2O$ solution on Zn surface. d) XRD patterns of RGO and RGO/Mn_3O_4 films. e) SEM image of RGO/Mn_3O_4 composite film. f) Optical image of a RGO/Mn_3O_4 composite film (≈1200 cm^{-2}). g) CV curves under different values of L/L_0, inset optical images: L_0 is the initial length of substrates, and L is the distance between two ends of films in different bending states. h) CV curves of two asymmetric microsized supercapacitors in series and a single device, scan rate: 10 V s^{-1}. i) GCD curves of the two asymmetric microsized supercapacitors in series and a single device, current density: 0.4 mA cm^{-2}.