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# One-step hydrothermal synthesis of sandwich-type NiCo<sub>2</sub>S<sub>4</sub>@reduced graphene oxide composite as active electrode material for supercapacitors

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## Highlights

- Sandwich-type NiCo<sub>2</sub>S<sub>4</sub>@RGO was first prepared successfully by hydrothermal process.
- This electrode exhibits a high specific capacitance of 2003 F/g at 1 A/g.
- With 86% capacitance retention from 1 A g<sup>-1</sup> to 20 A g<sup>-1</sup>.
- NiCo<sub>2</sub>S<sub>4</sub>@RGO//AC exhibits a high energy density of 21.9 Wh kg<sup>-1</sup> at 417.1 W kg<sup>-1</sup>.

**Abstract:** A facile one step hydrothermal process is developed for the synthesis of NiCo<sub>2</sub>S<sub>4</sub>@reduced graphene oxide (NiCo<sub>2</sub>S<sub>4</sub>@RGO) composite as electrode for electrochemical supercapacitors. This NiCo<sub>2</sub>S<sub>4</sub>@RGO electrode exhibits an ultrahigh specific capacitance of 2003 F g<sup>-1</sup> at 1 A g<sup>-1</sup> and 1726 F g<sup>-1</sup> at 20 A g<sup>-1</sup> (86.0% capacitance retention from 1 A g<sup>-1</sup> to 20 A g<sup>-1</sup>), excellent cycling stabilities (86.0% retention after 3500 cycles). Moreover, an asymmetric supercapacitor is successfully assembled by using NiCo<sub>2</sub>S<sub>4</sub>@RGO nanoparticle as the positive electrode and active

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