



Most Trusted. Most Cited. Most Read.

ADVERTISEMENT

RETURN TO ISSUE

< PREV **BATTERIES AND ENERGY...** NEXT >[Get e-Alerts](#)

# Sulfur-Doped Graphene as a Rational Anode for an Ionic Liquid Based Hybrid Capacitor with a 3.5 V Working Window

Navajsharif S. Shaikh, Vaibhav C. Lokhande, Pimsuda Pansa-Ngat, Shivaji Ubale, Jasmin S. Shaikh, Supareak Praserttham, Sandip R. Sabale, Chandrakant D. Lokhande\*, Teekaporn Jit and Pongsakorn Kanjanaboos\*

✓ **Cite this:** *Energy Fuels* 2022, 36, 5, 2799–2810

Publication Date: February 9, 2022

<https://doi.org/10.1021/acs.energyfuels.1c03625>

Copyright © 2022 American Chemical Society

[Request reuse permissions](#)

## Pimsuda Pansa-Ngat

School of Materials Science and Innovation, Faculty of Science, Mahidol University, Nakhon Pathom 73170, Thailand

[More by Pimsuda Pansa-Ngat](#)

Article Views

481

Altmetric

-

Citations

5

[LEARN ABOUT THESE METRICS](#)

Share Add to Export



Access Through Your Institution

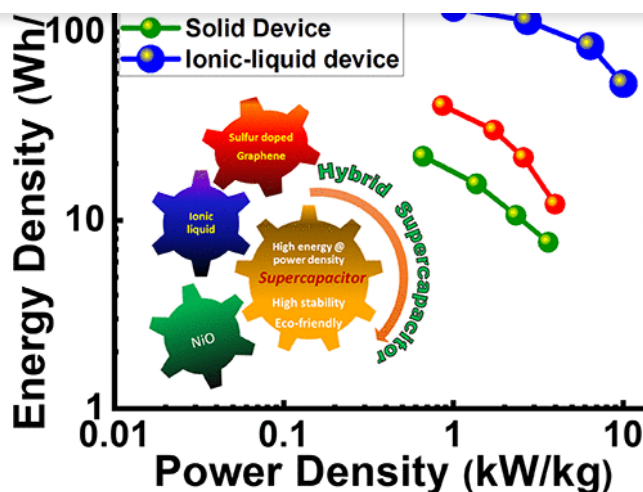
Other access options

[SI Supporting Info \(1\) »](#)

**SUBJECTS:** [Electrical properties](#), [Electrodes](#), [Electrolytes](#), [Energy density](#), [Oxides](#)



Most Trusted. Most Cited. Most Read.



In this work, the facile thermal annealing of graphene oxide in a  $\text{H}_2\text{S}$  atmosphere was used to obtain sulfur-doped graphene (SG) for anode materials for supercapacitors. The high electrical conductivity and the interconnected micro-pore structure of the SG electrode assisted in the fast transportation of electrons and ions at the electrode–electrolyte interface in the developed hybrid supercapacitors. The SG-based electrode resulted in an excellent specific capacitance of 460 F/g at 1 A/g. The nickel oxide could be obtained by a simple hydrothermal method, exhibiting a specific capacitance of 1236 F/g in 1 M KOH. The fabricated solid-state hybrid devices (Ss-HSCs) showed a high energy density of 21.8 Wh/kg at 661.7 W/kg power density with substantial cycling stability up to 89.0% over 1000 cycles in the PVA-KOH solid electrolyte. Considering pragmatic usages in heavy-duty appliances and hybrid vehicles, we fabricated quasi-solid-state ionic liquid BMIM- $\text{PF}_6$ /DMF based hybrid supercapacitors (Iq-HSCs) that were operated at 3.5 V. The Iq-HSC devices were capable of delivering 134.6 Wh/kg of the energy density at 1005.7 W/kg and the high power density with 69.3% capacitance retention over 1000 cycles.

## Read this Article

To access this article, please review the available access options below.



This website uses cookies to improve your user experience. By continuing to use the site, you are accepting our use of cookies. [Read the ACS privacy policy.](#)

**CONTINUE**