Received: 28 April 2022 | Revised: 8 July 2022 | Accepted: 13 July 2022

DOI: 10.1002/er.8447

RESEARCH ARTICLE

INTERNATIONAL JOURNAL OF ENERGY RESEARCH WILEY

MoS_2 nanosheets as bifunctional electrode for oxygen evolution reaction and electrochemical supercapacitor

Komal B. Pisal[1] | **Bapuso M. Babar**[1] | **Sarfraj H. Mujawar**[1] | **Sawanta S. Mali**[2] | **Chang Kook Hong**[2] | **Shrikrishna D. Sartale**[3] | **Laxman D. Kadam**[4]

[1]Department of Physics, Yashavantrao Chavan Institute of Science, Satara, India

[2]Polymer Energy Materials Laboratory, School of Advanced Chemical Engineering, Chonnam National University, Gwangju, South Korea

[3]Thin Films and Nanomaterials Laboratory, Department of Physics, Savitribai Phule Pune University, Pune, India

[4]Department of Physics, Arts, Science and Commerce College, Ramanandnagar, Sangli, India

Correspondence
Laxman D. Kadam, Arts, Science and Commerce College, Ramanandnagar, Sangli, Maharashtra 416308, India.
Email: kdlaxman_222@yahoo.co.in

Funding information
Chhatrapati Shahu Maharaj Research Training and Human Development Institute (SARTHI), Pune (CSMNRF-2019); Yashavantrao Chavan Institute of Science, Satara (UGC-CPE, DST-FIST, RUSA (component 8), DBT-STAR schemes)

Summary

In recent years, the demand for economic multifunctional materials for oxygen evolution reaction (OER) and supercapacitors increased tremendously. The present study focuses on the synthesis of mesoporous molybdenum disulfide nanosheets using a facile and cost-effective hydrothermal technique. The influence of acidic, alkaline, and neutral pH conditions on structural, morphological, and electrochemical properties of MoS_2 has been studied in detail. The intense (0 0 2) diffraction peak evidence the growth of MoS_2 along the c axis of hexagonal crystal structure. The MoS_2 prepared in acidic pH condition exhibit less stacking of MoS_2 layers. The pH 3 MoS_2 sample possesses high specific surface area and hence affords abundant electroactive sites. The electrochemical measurements were carried out using cyclic voltammetry, galvanostatic charge-discharge, linear sweep voltammetry, and electrochemical impedance spectroscopy. The results show that the high specific capacitance of 857 F/g at 5 mV/s scan rate was achieved for the MoS_2 prepared under acidic pH conditions. Further, the electrode exhibits cyclic stability of 78% even after 1000 cycles. Also, in oxygen evolution reaction, MoS_2 electrocatalyst requires an overpotential of 299 mV to deliver a current of 25 mA/cm^2. These results suggest that MoS_2 nanosheets can serve as a potential candidate as an electrode for OER and supercapacitors.

KEYWORDS

hydrothermal, MoS_2, OER, pH, supercapacitor

1 | INTRODUCTION

Climate change and global warming are the buzzwords in the new millennium. The 19th and 20th centuries saw the unprecedented demand for fossil fuels and energy needs sky-rocketed. New market dynamics demand portable electric and electronic devices, especially in the electric mobility solutions, there is an urgent demand for reliable and sustainable high-power energy resources. Simple principle, long cycle life, pulse power supply, and high charge propagation make the supercapacitors a leading contender for this solution and call for attention from both researchers as well as industry experts.[1] Rechargeable batteries used in day-to-day use and supercapacitors work on a similar principle with positive and negative electrodes and separators soaked in electrolytes. On account of their obvious advantages of high-power density, superior charge/discharge rates, and longer life

