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Recent Advances in Transition-Metal Doped MoS_2 Nanostructures for Flexible Supercapacitor Electrodes

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Abstract

Transition metal chalcogenides (TMCs) are promising materials for flexible supercapacitors (FsCs) as an energy storage device for next-generation flexible and wearable electronics. Because of their large theoretical capacitance and faradic charge-storage mechanism, TMCs can provide excellent capacitance and energy density when utilized as a pseudocapacitive or battery-like electrode. Among this, molybdenum disulfide (MoS_2) emerged as a promising

material due to its high surface area, tunable bandgap, and layered structure. This review provides a comprehensive analysis of MoS_2 as a key material in FsCs technology, focusing on its fundamental properties, mechanism, morphology, and structural design. Furthermore, this review explores recent advancements in MoS_2-based hybrid materials and their integration with conductive substrates or other nanomaterials to improve overall device performance. The review also explores the challenges, such as low electrical conductivity and restacking issues, and addresses the ways to overcome. After all, the role of MoS_2 in sustainable electrode materials, its contributions, and its development are underscored in this review.

Keywords
Transition metal chalcogenides (TMCs), Flexible supercapacitors (FsCs), Molybdenum disulfide (MoS_2), Nanomaterials, Restacking.