$MoS_2/Ti_3C_2T_x$ MXene Composite Cathode for High Performance Zinc-Ion Batteries

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Aqueous zinc-ion batteries (ZIBs) are gaining increasing interest as next-generation energy storage devices due to their intrinsic safety, eco-friendliness, and high theoretical capacity [1]. Among various cathode candidates, layered molybdenum disulfide (MoS_2) offers considerable promise; however, its sluggish charge transport and poor wettability severely restrict electrochemical performance [2]. Herein, a $MoS_2/Ti_3C_2T_x$ MXene composite cathode is developed through a facile one-step hydrothermal strategy, enabling the vertical anchoring of ultrathin MoS_2 nanosheets onto $Ti_3C_2T_x$ MXene layers. The conductive and hydrophilic $Ti_3C_2T_x$ MXene effectively enhances electrolyte accessibility, mitigates structural degradation of MoS_2 during repeated Zn^{2+} insertion/extraction, and promotes rapid electron transport. As a result, $MoS_2/Ti_3C_2T_x$ composite exhibits a high specific discharge capacity of 160 mA h g^{-1} at 0.1 C rate, along with remarkable cycling stability. This work highlights the synergistic integration of MXene and transition metal dichalcogenides as an efficient route toward high-capacity and durable cathode materials for zinc-ion batteries.

References

[1] W. Su, M. Lang, Q. Zhang, Y. Yang, H. Li, and F. Zhang, "Vertically aligned MoS2 nanosheets on monodisperse MXene as electrolyte-philic cathodes for zinc ion batteries with enhanced capacity," RSC Adv., vol. 13, no. 26, pp. 17914–17922, Jun. 2023, doi: 10.1039/d3ra02352d.

[2] W. Yang et al., "Mn2+-Doped MoS2/MXene Heterostructure Composites as Cathodes for Aqueous Zinc-Ion Batteries," ACS Appl. Mater. Interfaces, vol. 15, no. 44, pp. 51231–51240, Nov. 2023, doi: 10.1021/acsami.3c12494

Figures

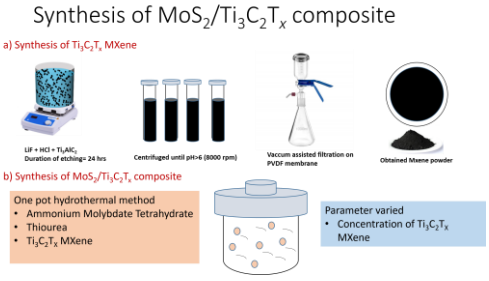

Figure 1: Schematic illustration of the synthesis of $MoS_2/Ti_3C_2T_x$ MXene composite.

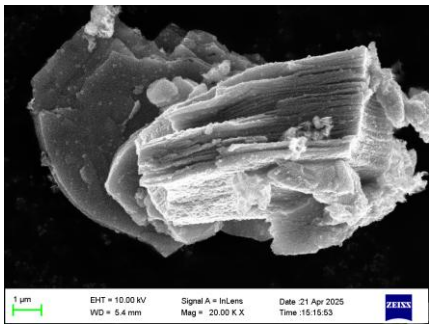

Figure 2: FESEM image of vertically aligned MoS_2 over $Ti_3C_2T_x$ MXene layers.