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Cr_2O_3-modified graphite felt as a novel positive electrode for vanadium redox flow battery

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Abstract

In this work, we investigate a facile modification approach for depositing novel electrocatalyst of chromium oxide on graphite felt via impregnation in conjunction with unltrasonication in order to improve the electrochemical performance of the positive electrode in the vanadium redox flow battery (VRFB). The modified graphite felt with an ultra-thin coating layer of Cr_2O_3 not only promotes the activity and reversibility of VO^{2+}/VO_2^+ redox reactions, but also exhibits excellent stability in repetitive cyclic voltammetry. The flow cell employing the modified graphite felt electrodes demonstrates enhanced performance with voltage efficiency and energy efficiency of 75.9% and 67.6% at a high current density of 150 mA cm^{-2}, which are much higher than that of 66.9% and 56.8% obtained from the cell employing pristine graphite felt. Moreover, the utilization depth of the cell is significantly enhanced as the discharge capacity increases by 83.6%. The cycling test demonstrates the stability of the Cr_2O_3 coating layer on graphite felt, where no significant decay in efficiencies was observed. The results verify stable and significantly enhanced catalytic effect of chromium oxide in providing active sites and promoting the electrochemical performance of graphite felt in the VRFB.

Keywords: vanadium redox flow battery, graphite felt, chromium oxide, electrocatalyst