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Nanocrystalline CeO_{2-δ} coated β-MnO₂ nanorods with enhanced oxygen transfer property

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Abstract: In this research, β-MnO₂ nanorods were synthesized by a hydrothermal method, followed by a facile precipitation method to obtain nanocrystalline CeO_{2-δ} coated β-MnO₂ nanorods. The as-prepared samples were characterized by XRD, HRTEM, FESEM, XPS and in-situ high-temperature XRD. The HRTEM results show that well dispersed CeO_{2-δ} nanocrystals sized about 5 nm were coated on the surface of β-MnO₂ nanorods. The oxygen storage and transfer property of as-synthesized materials were evaluated using TGA under various atmospheres (air, pure N₂, and 5% H₂/95% Ar). The TGA results indicate that CeO_{2-δ} modification could favour the reduction of Mn⁴⁺ to Mn³⁺ and/or Mn²⁺ at lower temperature as compared with pure β-MnO₂ nanorods and the physically mixed CeO_{2-δ}-β-MnO₂ under low oxygen partial pressure conditions (i.e., pure N₂, 5% H₂/95% Ar). Specifically, CeO_{2-δ}@β-MnO₂ sample can exhibit 7.5 wt% weight loss between 100 and 400 °C under flowing N₂ and 11.4 wt% weight loss between 100 and 350 °C under flowing 5% H₂/95% Ar. During the reduction process under pure N₂ or 5% H₂/95% Ar condition, the oxygen ions in β-MnO₂ nanorods are expected to be released to the surroundings in the form of O₂ or H₂O with the coated CeO_{2-δ} nanocrystals acting as mediator as inferred from the synergistic effect between the well-interacted CeO_{2-δ} nanocrystals and β-MnO₂ nanorods.

Keywords: CeO_{2-δ}; β-MnO₂; oxygen transfer; synergetic effect

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