Cyclic ageing of titanium-supported lead dioxide electrodes for bipolar battery applications

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Abstract

Titanium foil coated with doped tin dioxide is very attractive option for positive current collector interface of bipolar lead batteries due its outstanding corrosion resistance and excellent mechanical performance. Despite these advantages, lead dioxide electrodes prepared by pasting and formation exhibit rather poor capacity retention during cycling with moderate depth of discharge. The phosphoric acid and two of its derivatives, one inorganic (calcium hydrogen phosphate) and one organic (poly-vinylphosphonic acid), have been studied as additives with potential for improvement of the capacity retention of such positive electrodes. The experiments have been carried out on small-scale working electrodes with construction resembling the end-plate electrode of a bipolar battery. The electrochemical cells employed oversized conventional negative plate and externally compressed AGM separators. The results showed that the jar-formation process in the sulfuric acid electrolyte containing phosphoric acid overcomes successfully the capacity retention problem at all studied cases. It leads also to considerable improvement of the lead dioxide utilization. The cycling ageing of the electrodes combined with periodic impedance spectroscopy measurements, indicated progressive capacity loss corresponding to the typical processes of degradation of the lead dioxide structure and rather small changes in the electrode resistance, thus proving the corrosion resistance of the current collectors. It is concluded that the combined doping with phosphoric acid species in the electrolyte and in the positive paste offers a potential for further improvements of the electrodes cyclability.

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