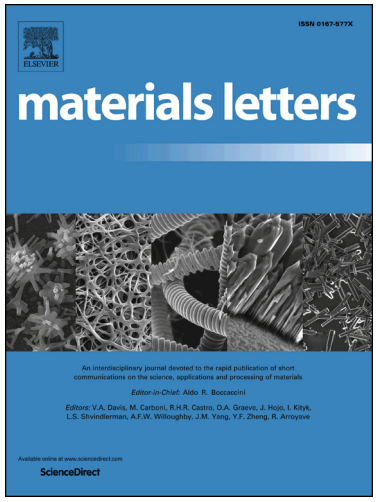

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Enhancing cycle performance of lead-carbon battery anodes by lead-doped porous carbon composite and graphite additives

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ABSTRACT

By using both lead-doped porous carbon composite and graphite, a hybrid carbon additive was designed to inhibit irreversible sulfation so as to enhance the cycle performance of lead-carbon battery anodes. The synergistic action mechanism was studied. We show that the hybrid carbon additive presents a unique structure of sheets attached to porous bulk, and this structure could confine the lead particles between graphite sheet and porous carbon to independently proceed the higher-rate charge-discharge testing. The separated lead nanoparticles could effectively inhibit the hydrogen evolution induced by carbon and enhance the reversible reaction of $Pb/PbSO_4$, which prolong the cycle life of lead-carbon batteries.

Keywords: Carbon materials, Graphite, Porous carbon, Nano-lead electrodeposition, Irreversible sulfation, Lead-carbon batteries.

1. Introduction

Lead-carbon batteries with carbon materials as the negative additives, have excellent cycle life under High-rate partial-state-of-charge (HRPSoC) conditions in energy storage field [1–3]. Such as carbon black or graphite could improve the cycle performance of batteries due to their high electric conductivity [4], and porous carbon materials have attracted an extensive attention owing to the abundant pore structure and good electric double-layer performance [5,6]. Recently some studies reported that the lead deposits on the surface of porous carbon additives could inhibit the hydrogen evolution, provide more directions for current distribution, and thereby effectively enhance the reversible reaction of $Pb/PbSO_4$ [7]. Our past work first verified that the lead particles on the external surface of porous carbon could be