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Carbon felt-polypyrrole-silver chloride composite as positive materials for rechargeable magnesium batteries

Aleksandra S. Popović[1], Branimir N. Grgur[1]

[1]University of Belgrade Faculty of technology and metallurgy department of physical chemistry and electrochemistry, Karnegijeva 4, 11020 Belgrade, Serbia

Over the last decades we are witnesses of astonishing development of different electrode materials for alkali-ion and metal-air batteries, supercapacitors, and supercapattery. Even so, some rather old electrochemical systems have still space for further improvement. Seawater-activated primary battery, as another example of the old systems, discovered in 1878 and developed by Bell Telephone Laboratories in 1945 as the power source for electric torpedoes, are used for a wide range of applications. Among many different cathode materials, silver chloride (AgCl) and lead chloride (PbCl2) are most widely applied. An improvement of AgCl synthesis is reported in our previous work in which the fast and low-cost modified process of successive ion layer adsorption and reaction (SILAR) is effectively applied to form carbon felt-silver chloride cathode materials for primary cell.

In this work we investigated electrochemical synthesis of polypyrrole on a carbon felt (CF/PPy) electrode. Further, the CF/PPy electrode is modified by AgCl by applying modified SILAR method. Using the cyclic voltammetry and charge-discharge techniques, it is shown superior behavior of composite CF/PPy-AgCl electrode. For the possible rechargeable aqueous based magnesium alloy AZ63 |3.5% NaCl | CF/PPy-AgCl cell in the current range of 135 to 1350 A g-1 the specific capacity in the range of 35-25 Ah kg-1, energy of 45-25 Wh kg-1 and power of 100 to 1600 W kg-1 are obtained. Also the cyclic stability is determined, and concluded that such a simple cell using small photovoltaic cell could be charged at least 100 times, depending of Mg-alloy mass. The possibilities of further improvement of the system is considered.

Keywords: elevrvode materiams, polypyrrole, carbon felt (CF/PPy) electrode

Corresponding author: apopovic@tmf.bg.ac.rs

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