Copper-phosphide Carbon Composite as Negative Electrode for Sodium Secondary Battery using Ionic Liquid Electrolyte

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Transition metal phosphides are getting huge attention owing to the large reversible capacity based on the conversion mechanism [1]. Recently, copper phosphide achieved good electrochemical performance as negative electrodes for sodium-ion batteries [2, 3]. Ionic liquids (ILs) are composed of cation and anion which show negligible flammability and volatility, high thermal stability and wide electrochemical window. Moreover, at intermediate temperatures, high rate performance has been reported with ILs [4]. Therefore, a good performance is expected from the combination of CuP_2/C and intermediate-temperature operation with IL. In this work, copper-phosphide carbon composite (CuP_2/C) was investigated as a negative electrode for sodium secondary batteries using the Na[FSA]–[C_3C_1pyrr][FSA] (FSA = bis(fluorosulfonyl)amide anion and C_3C_1pyrr = *N*-methyl-*N*-propylpyrrolidinium cation) IL as an electrolyte. The CuP_2/C was prepared by a simple two step ball-milling procedure. Firstly, copper metal powder and red phosphorus powder were ball-milled in stoichiometric ratio for 30 hours and then the obtained CuP_2 powder was again ball-milled with acetylene black (AB) in 80:20 wt% for 3 hours to prepare CuP_2/C composite. Figure 1 shows the charge-discharge performance of CuP_2/C composite with IL at 298 K and 363 K respectively. Excellent electrochemical performance was observed experimentally at both the temperatures. Charge-discharge mechanism was investigated with the aid of ex-situ XRD, TEM, SAED, and elemental analysis.

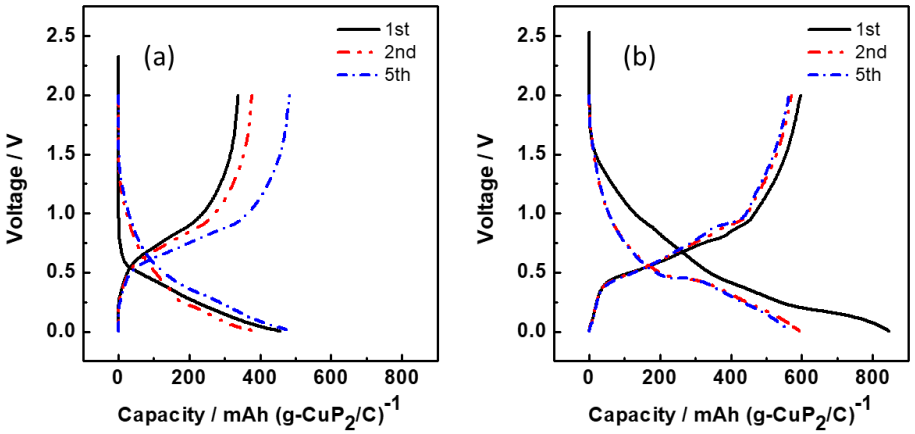

Fig 1. Galvanostatic charge-discharge curves of the CuP_2/C composite in Na[FSA]–[C_3C_1pyrr][FSA] (a) at 298 K, and (b) at 363 K (rate: 100 mA g^{-1}, voltage range: 0.005-2.000 V).

References:

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