One-step Synthesis of Amorphous ZnP2 Composite Anode Promoting the Fast-Charging Performance in Li-Ion Batteries

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Lithium-ion batteries (LIBs) plays a decisive role in the development of consumer electronics and electric vehicles (EVs). However, the problems of range anxiety and time-consuming charging also become more prominent. Fast charging is regarded to be a key requirement for widespread economic success of electric vehicles, but fast-charging LIBs suffer from slow kinetics and lithium plating limited by the graphite anode under high current density. To achieve fast charging, finding low-cost and large-capacity anode alternative materials is promoted. As an alternative to graphite, a series of P-based phosphides have impressed many researchers for its many advantages to high electronic conductivity, high capacity and sufficient source as anodes for rechargeable batteries. Inspired by these facts, I implemented a strategy of one-step synthesis of ZnP2/Zn3(PO4)2/C for fast-charging LIBs with commercially available zinc oxide (ZnO), red phosphorus (RP) and conductive carbon (C) / Super P by using the high-energy ball milling method, which is more environmentally friendly and convenient than conventional method. The amorphous a-ZnP2/Zn3(PO4)2/C36 showed a good capacity of 1705 mAh/g with at 0.1 A/g, with a capacity retention of 99.15% after 500 cycles. Furthermore, a-ZnP2/Zn3(PO4)2/C36 provided 613 mAh/g at 20A/g(12C) after 2000 cycles with capacity retention of 85.3%, showing a better buffering effect on volumetric expansion during cycling(139%) than c-ZnP2/Zn3(PO4)2/C23 (169%). It is worth mentioning that this is the state-of-the-art cycling performance among all the reported Zn–P system materials, and even transition metal phosphide (P–/Fe/Co/Ni/Cu series) electrodes