Microwave-assisted synthesis of LISICON structured $Li_3V_2(PO_4)_3$/ graphene composite

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One of the main challenges in cathodes at low temperatures (LT) is associated with low electronic and ionic conductivity. Graphene can be used to increase electronic conductivity, but most of the experimental methods for graphene composites require long-term high-temperature treatment and an inert atmosphere, which causes high energy consumption and cost increase. In comparison, microwave heating can simplify the reduction step of graphene oxide and provide a convenient, economical, and effective method of preparing graphene composites. LISICON structured $Li_3V_2(PO_4)_3$ (r-LVP) was reported to have enhanced LT performance due to high alkali-ion mobility and rhombohedral structure with the open framework.

In this study, r-LVP/graphene composite was successfully prepared using a microwave heating method. Microwave heating was used to simplify the reduction of graphene oxide and the synthesis of $Na_3V_2(PO_4)_3$ /graphene composite. The r-LVP/graphene composite was successfully obtained by ion exchange from the prepared $Na_3V_2(PO_4)_3$/graphene composite. The structure, morphology and electrochemical performances of r-LVP/graphene composite were systematically studied by X-ray diffraction (XRD), transmission electron microscopy (TEM), scanning electron microscopy (SEM), Raman spectroscopy, cyclic voltammetry (CV), charge/discharge tests and electrochemical impedance spectra (EIS). The XRD analysis indicated that graphene-modified r-LVP can be successfully obtained. Both SEM and TEM images revealed small r-LVP particles embedded in thin carbon layer sheets which could provide a high ionic and electronic conductivity. Raman analysis showed that graphene has a high degree of graphitization. When used as a cathode, the r-LVP/graphene composite exhibited high-rate ability and cyclic stability at low temperatures.

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