V_2O_5/graphene hybrid as superior cathode for lithium-ion batteries

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Abstract

To prevent the long-standing issues of low intrinsic electronic conductivity, slow lithium-ion diffusion and irreversible phase transitions on deep discharge of V_2O_5 electrode, a hybrid of V_2O_5 nanostructured with graphene is proposed as cathode for lithium-ion batteries. In this study, we develop a simple wet ball-milling method to create V_2O_5/graphene hybrid structure in which nanometre-sized V_2O_5 particles/aggregates are well embedded and uniformly dispersed into the crumpled and flexible graphene sheets generated by *in-situ* conversion of bulk graphite. The V_2O_5/graphene hybrid effectively leads to significant improvements in electronic conductivity, structural stability and ion diffusion, which in turn, results in excellent electrochemical performance. Low content of graphene results in a higher discharge capacity (185 mAh g^{-1}) at 1C rate, while high content of graphene leads to a lower discharge capacity (157 mAh g^{-1}), but much improved cycling stability. It is also demonstrated that this hybrid structure prevents self-aggregation of active materials and fully utilize the advantage of active materials by keeping effective contact area large between active materials, conductive additives and electrolyte. Therefore, this simple wet ball-milling method is offering new hope and possibilities to create various graphene based hybrid for large scale energy storage applications.

Keywords: graphene; in-situ generation; hybrid structure; cathode; lithium-ion batteries