Supplementary Information
Sandwich-like LiFePO4/graphene hybrid nanosheets: In situ catalytic graphitization and their high-rate performance for lithium ion batteries

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Experimental details

Materials synthesis*:* 20 mL of dodecylamine (5.000 g) containing ethanol solution was added into 80 mL of a mixed aqueous solution of ferrous chloride tetrahydrate (1.590 g) and ammonium dihydrogenphosphate (0.900 g) at 50 °C. The solid product was collected by centrifugation, washed by water and anhydrous ethanol repeatedly and dried under vacuum at 40 °C for 12 h. 4 mL of lithium chloride monohydrate (0.578 g) solution was added into the dry powder and dried under vacuum at 40 °C for 12 h. The mixture was heated at 680 °C for 12 h under argon.

Materials characterisation*:* X-ray diffraction (XRD) analysis was performed on a Philips X'Pro X-ray diffractometer with Cu Kα irradiation. The X-ray source was operated at 40 kV and 40 mA. Transmission electron microscopy (TEM) and high-resolution TEM (HRTEM) measurements were conducted with JEM-100S and JEM-2010 electron microscopes, using an accelerating voltage of 80 kV and 200 kV, respectively. Scanning electron microscopy (SEM) measurements were conducted with an S4800 instrument. Nitrogen sorption isotherms of the SLG hybrid nanosheets are collected at 77K using Micromeritics ASAP2020 equipment. BET and BJH models are respectively used for specific surface area and porosity evaluation.

Electrochemical measurements*:* The electrochemical properties of the sandwich-like $LiFePO_4$/graphene hybrid nanosheets were measured in CR2032 coin-type cells. The electrodes were fabricated using a mixture of the prepared powders (85 wt%), carbon black (electronic conductive additive, 7.5 wt%), and polyvinylidene fluoride (PVDF, 7.5 wt%) in N-methyl-2-pyrrolidone (NMP) to form a slurry. The slurry was spread onto aluminum foil and dried in an oven at 120 °C for 12 h under vacuum. In the measurement of electrochemical performance, Li metal was used as the negative electrode. The galvanostatic charge and discharge experiment of the cell was performed in the range of 2.0-4.2 V at room temperature. The cycling tests were controlled and monitored by automatic battery cyclers.

The SLG electrical conductivity was measured at room temperature by the 4-probe method (*Nat. Mater.*, 2002, **1**, 123.). The SLG powder was dried at 120 °C over night and pressed into pellets under 200 kPa at room temperature. Electrical measurements were performed with Keithley 2400 Digital Source Meter.

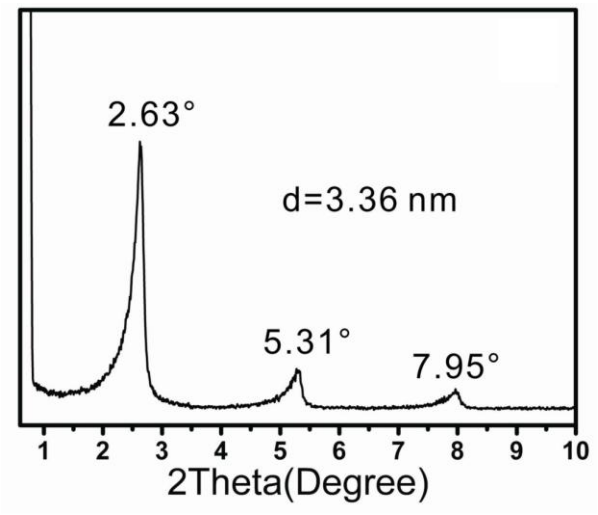

Figure S1 Small angle XRD pattern of the lamellar $FePO_4$ precursor.

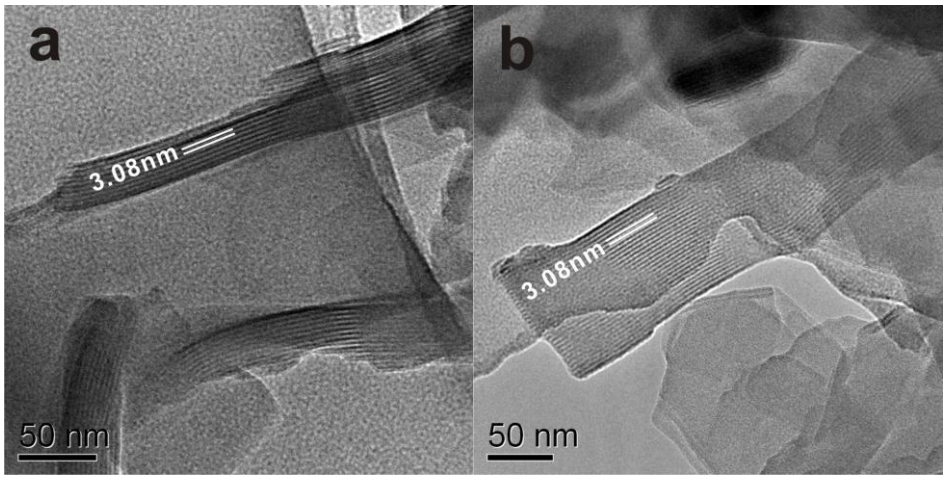

Figure S2 Typical TEM images of the lamellar $FePO_4$ precursor.

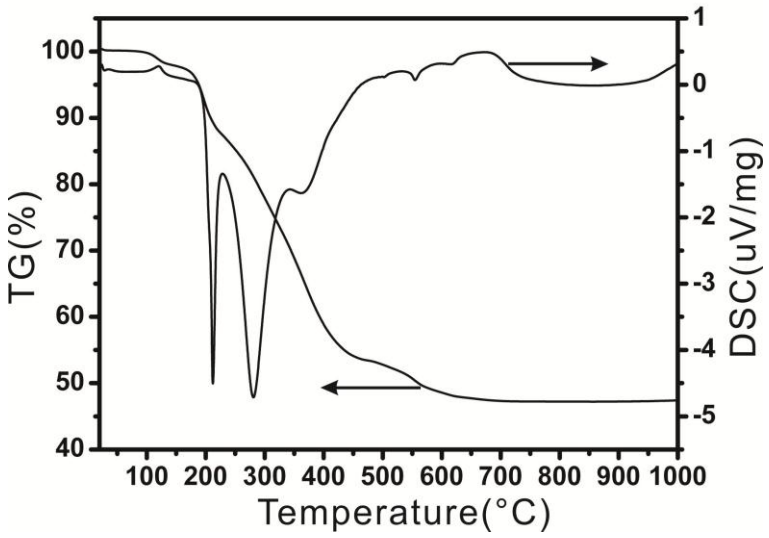

Figure S3 TG/DSC curves of the lamellar $FePO_4$ precursor.

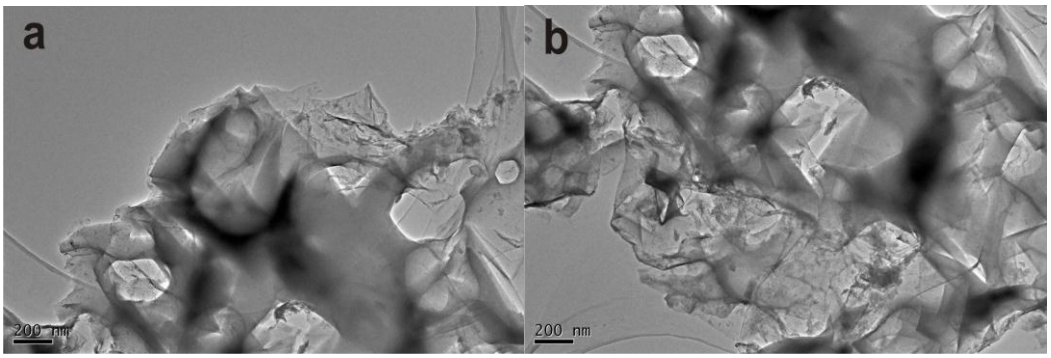

Figure S4 TEM images of the $LiFePO_4$/graphene hybrid nanosheets.

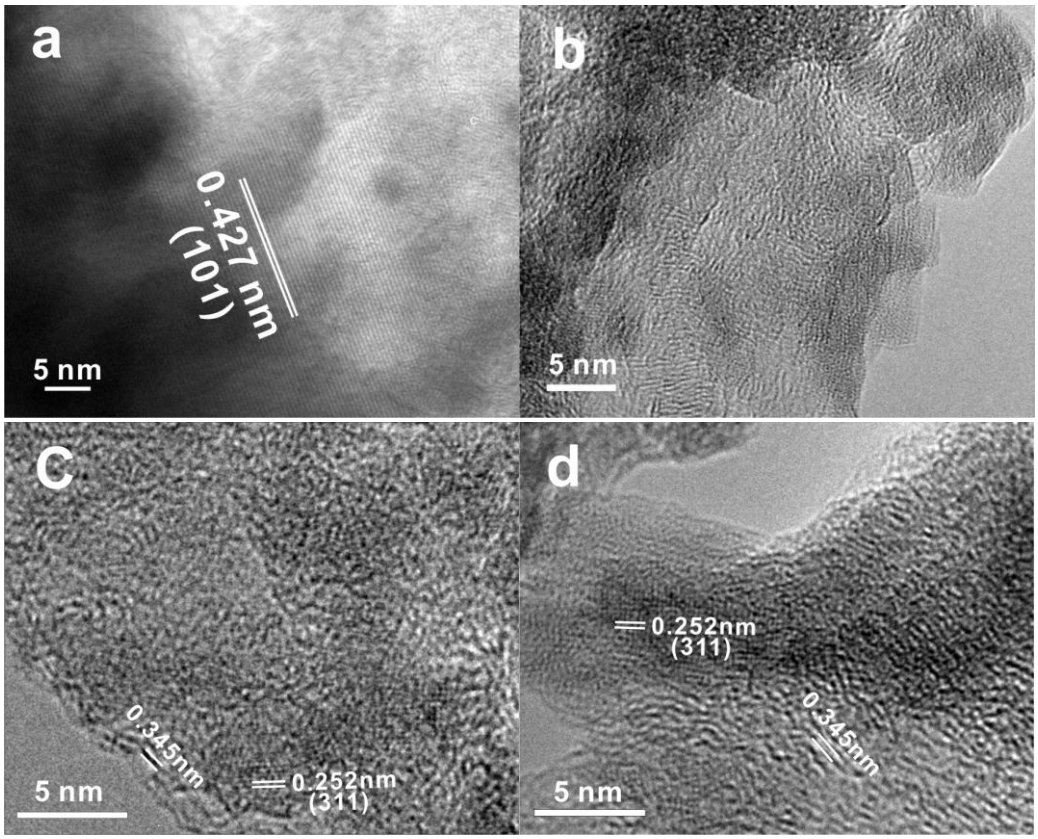

Figure S5 HRTEM images of the sandwich-like $LiFePO_4$/graphene hybrid nanosheets.

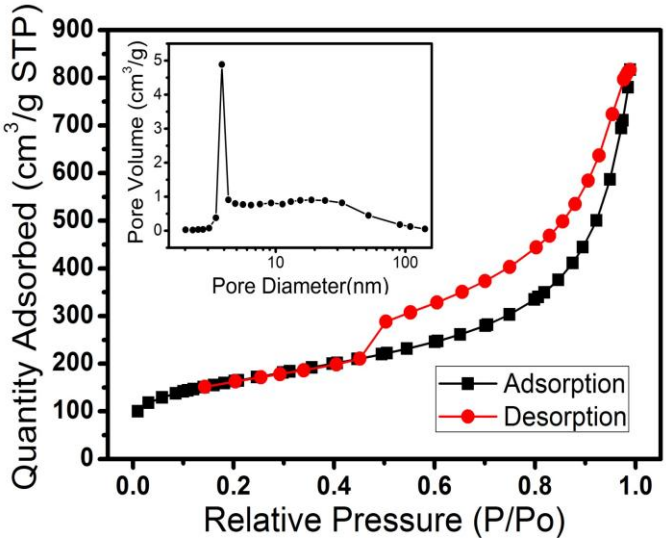

Figure S6 Nitrogen adsorption/desorption isotherms of the graphene parts taken from the hybrid nanosheets. Inset shows pore-size distribution plot calculated by the BJH formula in the desorption branch isotherm.

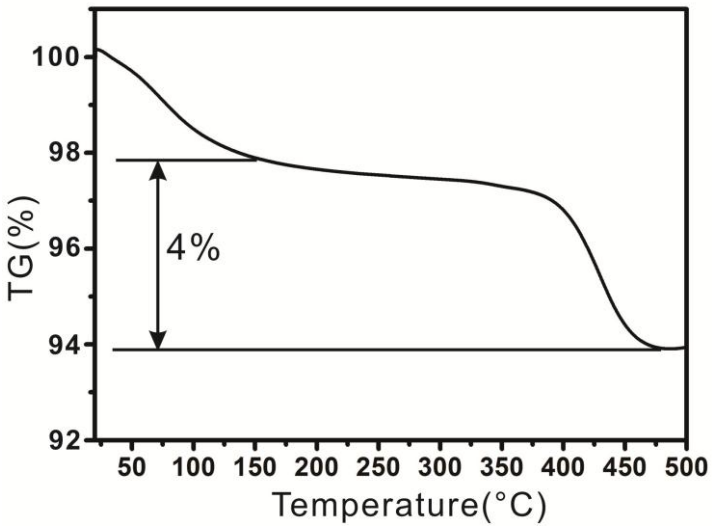

Figure S7 TG curves of the sandwich-like $LiFePO_4$/graphene hybrid nanosheets.

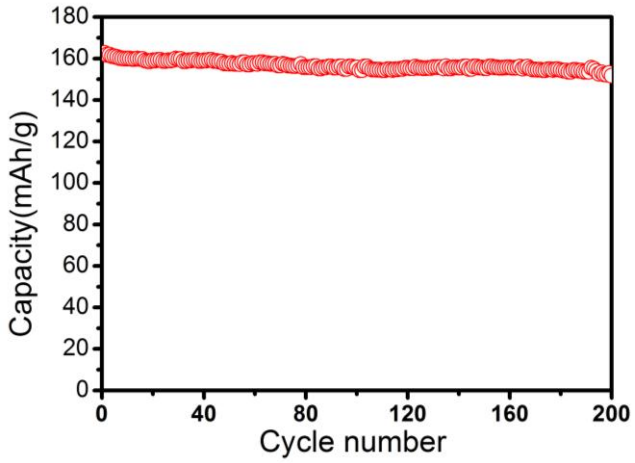

Figure S8 Discharge cycling performance of the sandwich-like $LiFePO_4$/graphene hybrid nanosheets at the rate of 1 C.