Enhanced cycling performance of nanostructure $LiFePO_4$/C composites with *in-situ* 3D conductive networks for high power Li-ion batteries

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The SEM and TEM images of LFP-S and LFP/C-S were measure in Fig.S1

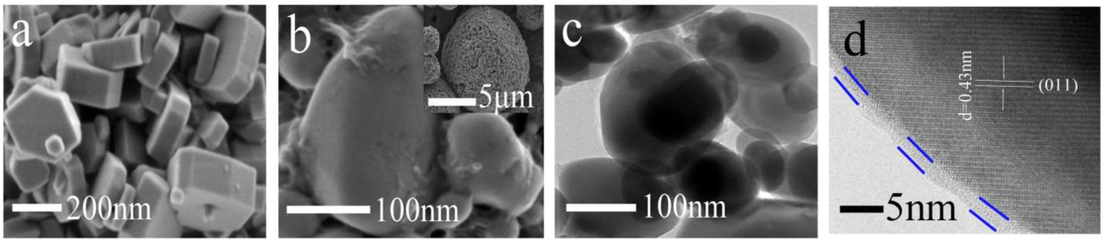

Fig.S1. SEM images for (a) LFP-S and (b) LFP/C-S, TEM images for (c, d) LFP/C-S

The Li^+ diffusion coefficient at open circuit state could be calculated from the slanted lines in the Warburg region by Eq. 1：[1]

$$D_{Li} = R^2T^2/2A^2n^4F^4C_0^2\sigma^2 \qquad (1)$$

where D_{Li} is the diffusion coefficient in $LiFePO_4$ ($cm^2\ s^{-1}$), R is the gas constant (8.31 J mol^{-1} K^{-1}), T is the absolute temperature (298 K), A is the surface area of active material, n is the number of electrons transferred per molecule during the electrochemical reaction, F is the Faraday constant (96485 C mol^{-1}), C_0 is the molar concentration of lithium ion in $LiFePO_4$ (1.1×10^{-2} mol cm^{-3} here), and σ is the Warburg factor associated with Z_{re} by Equation 2: [1]

$$Z_{re} = K + \sigma\omega^{-1/2} \qquad (2)$$

The Warburg factor can be obtained from the slope between Zre and the $\omega^{-1/2}$ where D_{Li} is the Li^+ diffusion coefficient in LFP ($cm^2 \cdot s^{-1}$), σ is the Warburg factor associated with Z_{Re} ($Z_{Re} \propto \sigma\omega^{-1/2}$). After linear fitting the relation plot between Z_{Re} and the reciprocal square root of the angular frequency ω, as shown in Figure S2, the σ of LFP/C-F and LFP/C-S were calculated to be 14.276 and 24.01 $\Omega \cdot s^{-1/2}$, respectively.

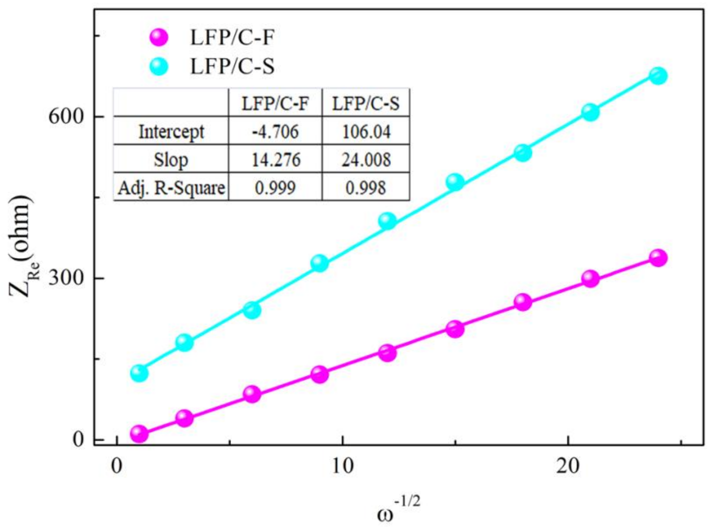

Fig.S2. the relationship between Z_{re} and the $\omega^{-1/2}$ of $LiFePO_4/C$ composites

Reference

[1] B. Wang, B. Xu, T. Liu, P. Liu, C. Guo, S. Wang, Q. Wang, Z. Xiong, D. Wang, X. S.Zhao, *Nanoscale* **2014**, *6*, 986.