As shown in Fig. S1, the cyclic voltammograms (CV) of LiFePO$_4$/CNT electrode was tested at 0.1, 0.5 and 1.0 mV/s, respectively. For the diffusion-limited process, the peak current is proportional to the square roots of the scan rate ($v^{-1/2}$) as the following Randles–Sevcik equation:

$$I_p = (2.69 \times 10^5) n^{3/2} A D^{1/2} C v^{1/2}$$  \hspace{1cm} (1)

Where $n$ is the number of transfer electrons ($n = 1$ for Fe$^{2+}$/Fe$^{3+}$ redox pair); $A$ is the surface of the electrode; $D$ is the diffusion coefficient; and $C$ is the concentration of reactants. The linear relations shows in Fig. S2 for the LiFePO$_4$/CNT indicates a diffusion-limited reaction. In addition, the slope of the fitted line is dependent on the diffusion coefficient of Li ion, and $D = 1.12 \times 10^{-10}$ cm$^2$ s$^{-1}$ is obtained according to Eq. (1), which is 3 ~ 4 orders higher than bare LiFePO$_4$ electrode ($10^{-13} ~ 10^{-14}$ cm$^2$ s$^{-1}$). Therefore, the prepared ionic conductivity LiFePO$_4$/CNT electrode is greatly improved.

**Fig. S1.** CV curves of LiFePO$_4$/CNT electrode at different scanning rates.

**Fig. S2.** The relation between peak current and the square roots of the scan rate.

**References**