Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information for

Depolarization effects of Li_2FeSiO_4 nanocrystal wrapped in different conductive carbon network as cathode for high performance lithium-ion batteries

Kai Wang, Wenju Ren, Jinlong Yang*, Rui Tan, Yidong Liu and Feng Pan*

School of Advanced Materials, Peking University Shenzhen Graduate School, Shenzhen 518055, China

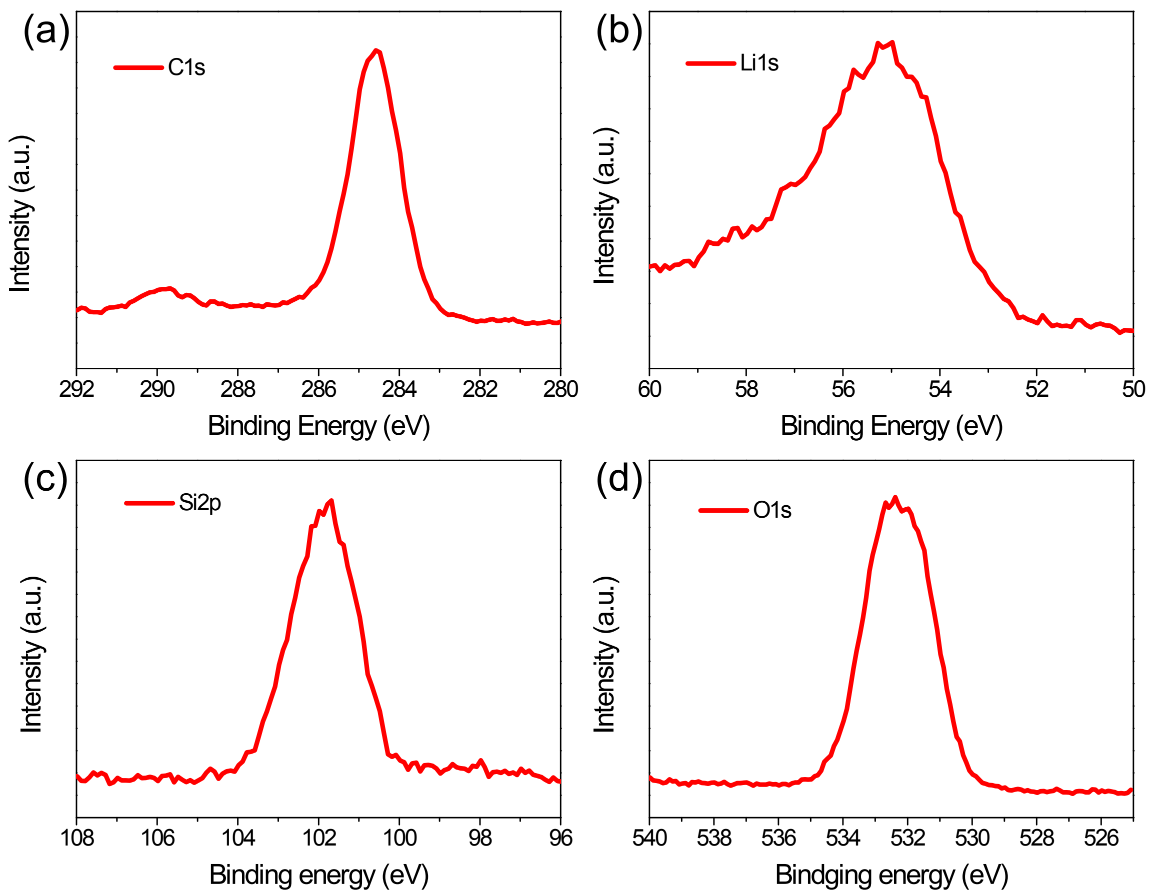

Fig. S1 XPS spectra of the as-prepared LFS sample (a) C1s, (b) Li1s, (c) Si2p, (d) O1s.

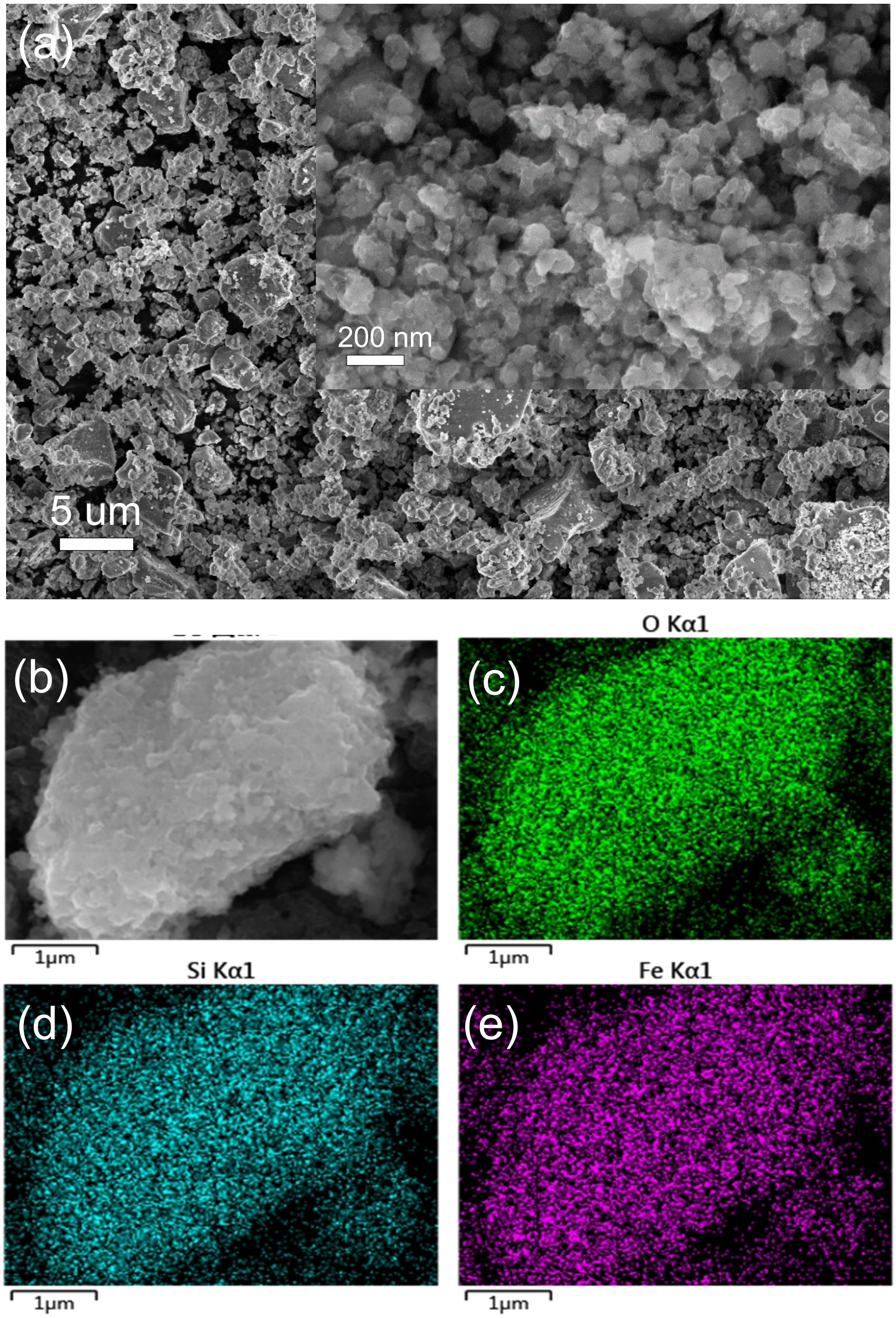

Fig. S2 (a) SEM images of the LFS sample. (b-e) EDX mapping of the LFS sample.

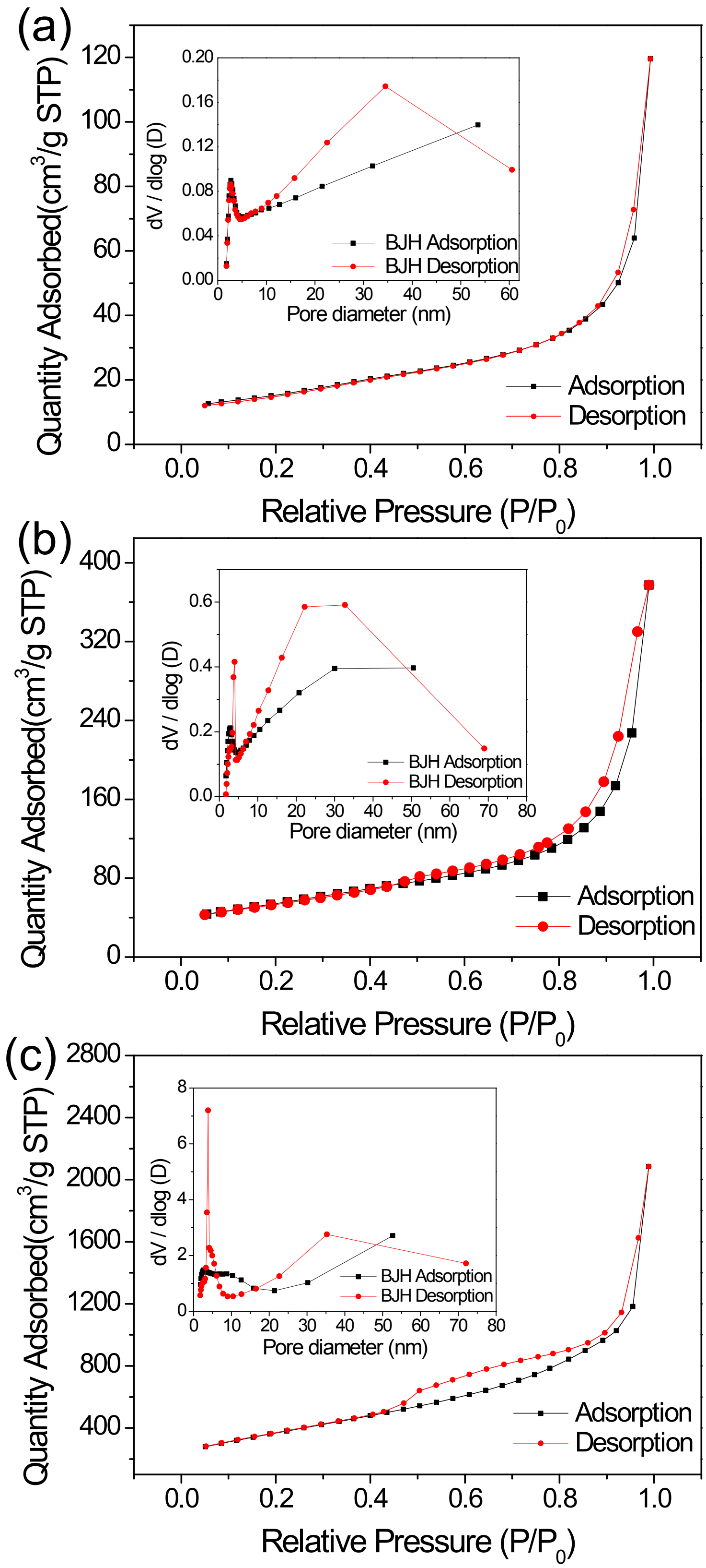

Fig. S3 Nitrogen adsorption and desorption isotherms at 77.47 K, (a)AB, (b) CNT and (c) KB, (the inset picture are the related pore-size distributions).

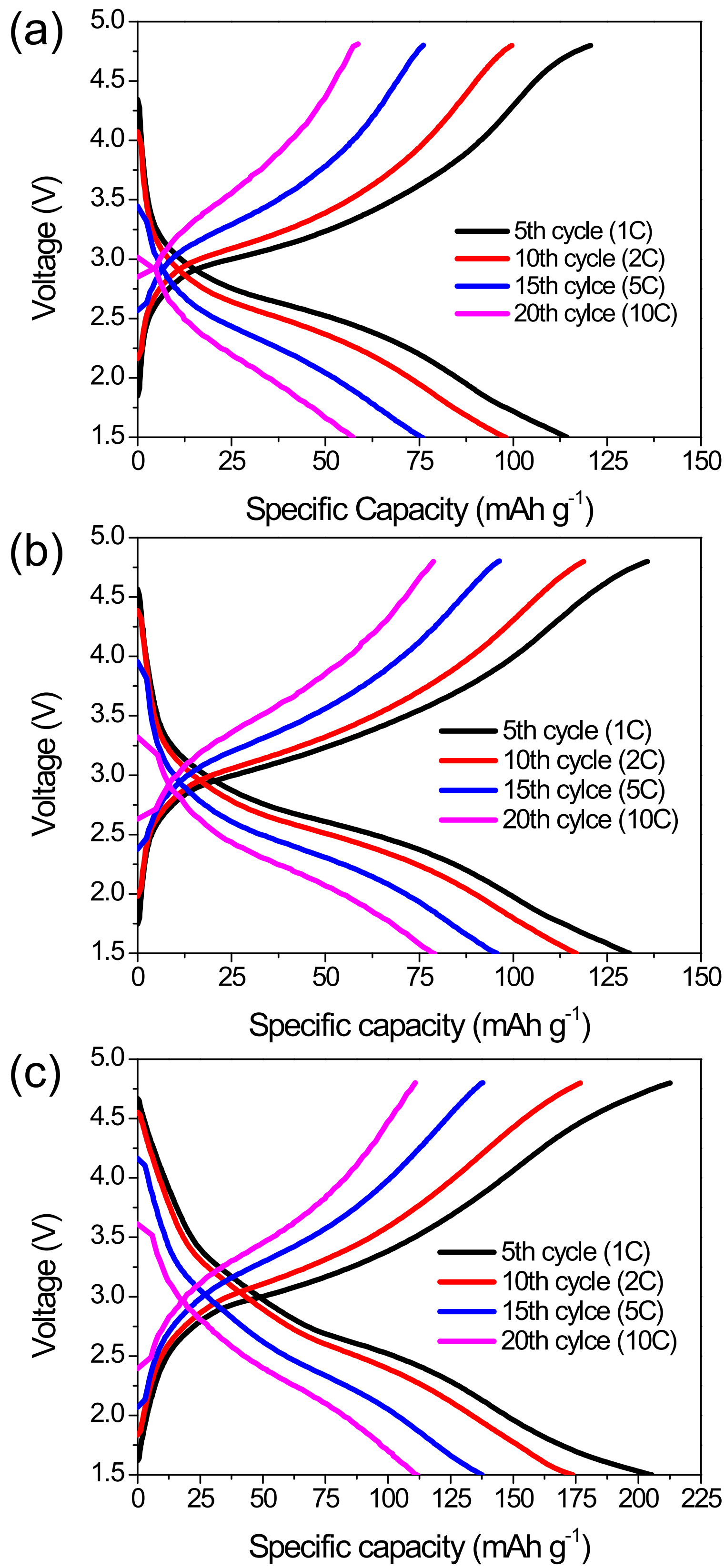

Fig. S4 Charge-discharge curves of (a) LFS@AB, (b) LFS@CNT and (c) LFS@KB.

Table S1 Fitted capacitance curve of nanocarbon as cathodes.

	Charge	Discharge
AB	$V=0.242\ C_{capacitance}+2.293$	$V=-0.254\ C_{capacitance}+3.987$
CNT	$V=0.117\ C_{capacitance}+2.192$	$V=-0.130\ C_{capacitance}+4.354$
KB	$V=0.025\ C_{capacitance}+1.999$	$V=-0.026\ C_{capacitance}+4.040$

So the capacitance contribution curve of the nanocarbon can be fitted as according to Table S1,

$$V_{voltage} = K.C_{capacitance} + B \quad (1)$$

from which we can get the capacitance contribution of the nanocarbon at each voltage dot as

$$C_{capacitance} = (V_{voltage} - B) / K \quad (2)$$

The final capacity at each voltage dot are get by subtracting the capacitance contribution from the original tested $V_{voltage}$-*Specific Capacity* curve,

$$C_{final\ capacity} = C_{test\ capacity} - 20\%\ C_{capacitance} \quad (3)$$

(20% is the content of the nanocarbon in the LFS@nanocarbon composites).

Methods for measurement of the electronic conductivity

The electronic conductivities of Nanocarbons (AB, CNT and KB) were tested by the KDJ-1A four-point probe instrument from Guanzhou Kunde Technology Co. Ltd. Nanocarbons were press into wafer at 20 MPa, the relationship of tested V-I spectra is shown in **Fig. S5**.

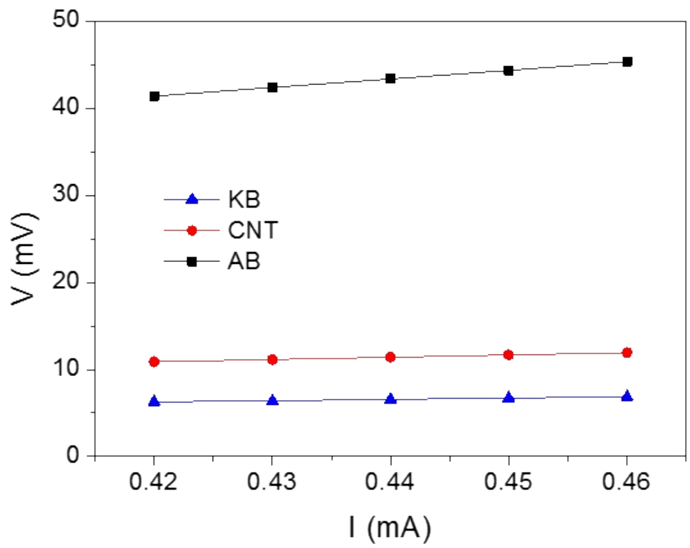

Fig. S5 The relationship of V-I tested by KDJ-1A four-point probe instrument for different nanocarbons pressed into wafer at 25 ºC.

The electronic conductivity was determined by the following equation:

$$1/\sigma = V/I \cdot W \cdot F_{sp} \cdot F_{W/S} \cdot F_{S/D} \cdot F_t \quad (4)$$

where σ is the conductivity, V is the voltage, I is the current, W is the thickness of wafer ($W = 0.08mm$), D is the diameter of wafer ($D = 12.7mm$), S is the probe spacing ($S = 1mm$), F_{sp} is the correction factor of probe spacing ($F_{sp} = 1.005$), $F_{W/S}$ is the correction factor of the thickness of wafer ($F_{W/S} = 0.9664$), $F_{S/D}$ is the correction factor of the diameter of wafer ($F_{S/D} = 4.2655$) and F_t is the correction factor of temperature($F_t = 1.0187$ when $t = 25°C$), respectively. The slope of V-I are get by linear fitting of the V-I spectra and the value is 98.7, 26.3 and 15.0 for AB, CNT and KB, respectively, which is used in equation (4) for calculation.

Due to the electronic conductivity of LFS is beyond the measuring range of the KDJ-1A four-point probe instrument (measuring range: $5*10^{-5}$~10^4 S cm^{-1}), and LFS@AB, LFS@CNT and LFS@KB electrode slices are fragile to be easily impaled by the four-point probe to make the readings of four-point probe instrument inaccurate, the electronic conductivities of LFS, LFS@AB, LFS@CNT and LFS@KB electrode slice are obtained by the following equation[1, 2]:

$$\sigma = L/(S*R) \tag{5}$$

where L is the thickness of electrode wafer slice (L=0.014 cm), S is the area ($S = \pi*0.5*0.5\ cm^2$) and R is the resistance (R = 25.5, 17.3 and 9.1 Ω for LFS@AB, LFS@CNT and LFS@KB electrode slice，respectively). For LFS , L=0.0442 cm， $S = \pi*0.5*0.5\ cm^2$， $R = 1*10^6\ \Omega$.

Refercens

1. M. Ding, K. Xu, S. Zhang, K. Amine, G. Henriksen and T. Jow, *J Electrochem Soc*, 2001, **148**, A1196-A1204.
2. R. Tan, J. Yang, J. Zheng, K. Wang, L. Lin, S. Ji, J. Liu and F. Pan, *Nano Energy*, 2015, **16**, 112-121.