

Dual-Doped Hollow Carbon Nanospheres Derived from Catechol/Polyamine as Sulfur Hosts for Advanced Lithium Sulfur Batteries

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Lithium-sulfur battery is considered as promising high-energy-storage system owing to its high theoretical specific capacity (1675 mAh g^{-1}) and energy density (2600 Wh kg^{-1}) [1]. However, its practical application is still hindered by fast capacity fading, which is mainly caused by the dissolution and shuttle of polysulfides. Therefore, developing effective materials to host sulfur species on the cathode is necessary. Recent work shows that doped carbon matrix exhibits strong adsorption for polysulfides [2], but it is still challenging to find efficient carbon presedure and understand the fundamental mechanism.

Herein, nitrogen/oxygen dual-doped hollow carbon nanospheres (DHCSs) was fabricated from catechol and polyamine (CPA) as sulfur hosts via hard-templating method. Compared with traditional carbon presedure, CPA can be easily and uniformly coated on most templates at room temperature without any surfactant or complex equipments (Fig.1b). The electrochemical measurements (Fig.1e, 1f) show that S/DHCSs delivers a stable cycling performance, remaining 851 mAh g^{-1} discharge capacity at 0.2 C with $\sim 0.08 \%$ capacity decay per cycle after 200 cycles. To investigate the fundamental mechanism, X-ray photoelectron spectroscopy and theoretical calculation is used. It finds the formation of S-O and S-C bond during heating diffusion (Fig.1g,1h), and demonstrates that N/O dual-atoms can provide stronger chemisorption than single-doping (Fig.1i). The results reveal the great advantages of dual-doped strategy, promising its potential application for energy storage.

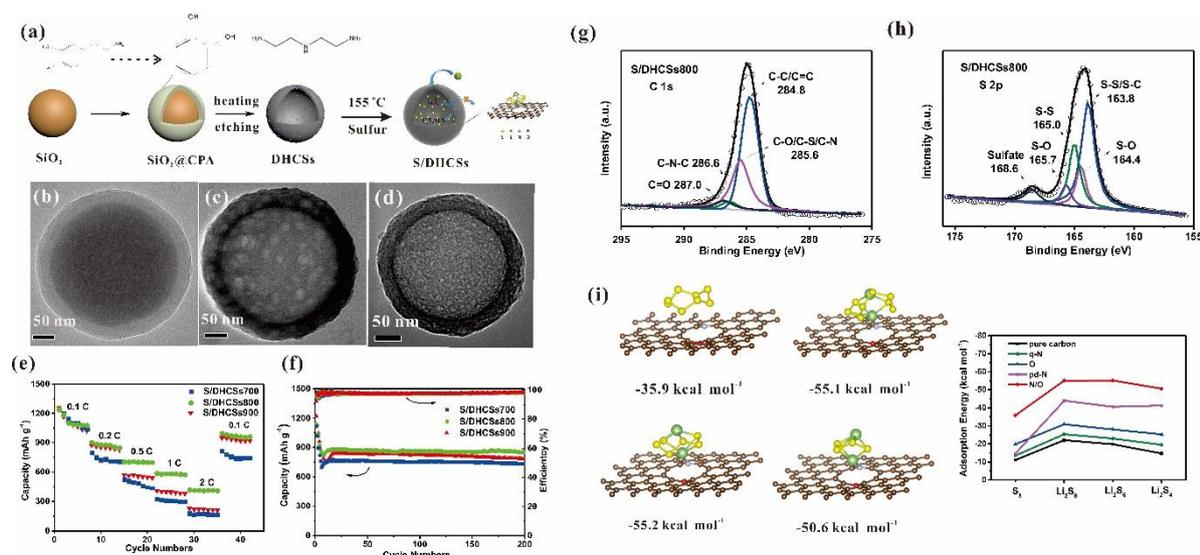


Fig. 1 (a) Schematic illustration, TEM images of (b) SiO₂@CPA, (c) DHCSs, (d) S/DHCSs, (e) rate performances, (f) cycling stability at 0.2 C, XPS spectra of S/DHCSs (g) C 1s (h) S2p, (i) optimized molecular configuration and corresponding calculated adsorption energy.

References:

- [1] P. G. Bruce, S. A. Freunberger, L. J. Hardwick, J. M. Tarascon, *Nature materials*, 11(2012), 19-29.
 [2] G. Zhou, E. Paek, G. S. Hwang, A. Manthiram, *Nat. Commun.*, 6 (2015) 7760-7770.