TRANSITION METAL ASSISTED SYNTHESIS OF TUNABLE PORE STRUCTURE CARBON WITH HIGH PERFORMANCE AS SODIUM/LITHIUM ION BATTERY ANODE

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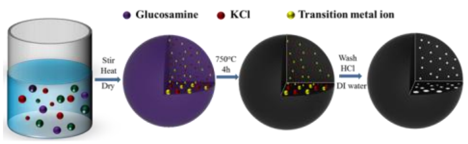
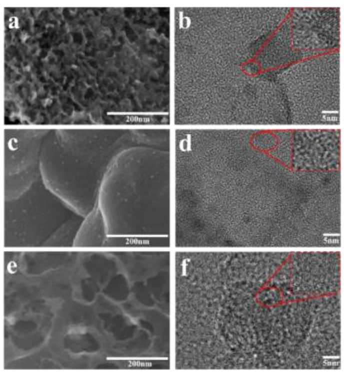
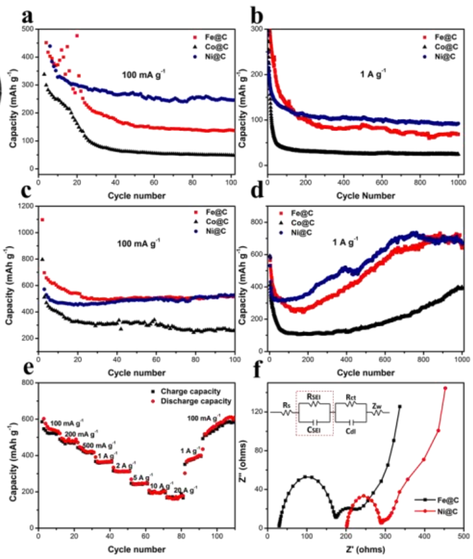
Template method has been used as an important method to prepare porous materials [1, 2]. However, there are few reports about template method employing potassium chloride as template. Here, potassium chloride is employed as a template to prepare the porous carbon, and transition metal nitrates ($Fe(NO_3)_2$, $Co(NO_3)_2$, $Ni(NO_3)_2$) are introduced to catalyze graphitization and to result different carbon structure during carbonization (denoted as Fe@C, Co@C and Ni@C). The Fe@C shows a formicary-like structure with an about 20 nm pore diameter and the Co@C displays a completely compact structure. Whereas, the Ni@C exhibits a foam-like structure with hierarchical porous structure consisting of macroporous frameworks, mesopores and ultrathin porous walls (~5 nm). Its macropore and mesopore diameter is around 100 nm and 4 nm, respectively, its specific surface area is 464.5 m^3 g^{-1}. When adopted as anode material, the Ni@C presents much outstanding rate and cycling capability for lithium and sodium storage than Fe@C and Co@C, the capacity for sodium storage is 260 mAh g^{-1} after 100 cycles at 100 mA g^{-1} and 92 mAh g^{-1} after 1000 cycles at 1A g^{-1}, and the capacity for lithium storage is 683 mAh g^{-1} after 1000 cycles at a current density of 1 A g^{-1}.



Schematic illustration for preparation process of porous carbon



Morphology images of Fe@C (a, b), Co@C(c, d) and Ni@C (e, f)



Cycling performance in SIB(a,b) and in LIB (c,d); (e) LIB rate performance of Ni@C; (f) Nyquist plot for LIB.

References:
[1] Inagaki M, Toyoda M, Soneda Y, Tsujimura S, Morishita T. Templated mesoporous carbons: Synthesis and applications. Carbon. 2016;107:448-473.
[2] Liang C, Dai S. Synthesis of mesoporous carbon materials via enhanced hydrogen-bonding interaction. J Am Chem Soc. 2006;128(16):5316-5317.