Layered Oxides with O3/P2 Hybrid Phases for Na-Ion Batteries

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With resource and cost advantage, Na-ion batteries have been regarded as the candidate for large scale energy storage systems, and the industrialization is in the near future.[1]

Layered oxide materials, usually divided into O3、P2、P3 and so on, are considered as the most promising cathode material for the real application. Higher capacity can be achieved by O3 type materials as they contain more sodium contents. Better rate capability, on the other hand, can be obtained for P2 structure because the Na+ diffusion energy barrier in the structure is smaller.

We thus investigate a hybrid structure of P2/O3, in order to combine both advantage of these two structures, and to have a balance among capacity, rate and cycling performance. Conventional solid state reaction was adopted to prepare the materials. The optimized material, P2/O3-$Na_{0.78}Ni_{0.2}Fe_{0.38}Mn_{0.42}O_2$, has a capacity of 86 mAh/g and 90% capacity maintained after 1500 cycles at 10C rate.[2] These results show great promise for the application.

Moerover, the influnce factor of the structure finally formed was also studied. We found that the decisive factor is sodium content. The structure changed from P2 to O3/P2, and to O3 with the increase of sodium, and 0.8 is usually the critical point. Sintering temperature also plays a role in the structure, however with a relative weak influence. These desining rules may offer a new vision during the material designing.

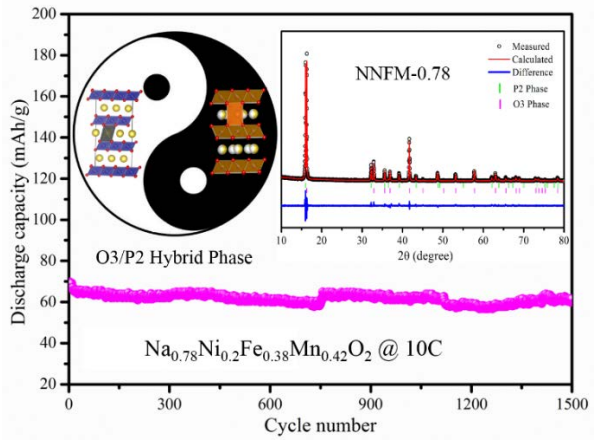

Figure. Structure and electrochemical performance of $Na_{0.78}Ni_{0.2}Fe_{0.38}Mn_{0.42}O_2$.

References:

[1] J. Deng, W.-B. Luo, S.-L. Chou, H.-K. Liu, S.-X. Dou, Adv. Energy Mater. 4 (2017) 1701428.
[2] X. Qi, L. Liu, N. Song, F. Gao, K. Yang, Y. Lu, H. Yang, Y.-S. Hu, Z.-H. Cheng, L. Chen, ACS Appl. Mater. Inter. 46 (2017) 40215-40223.