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The effects of sulfur anion doping on the performance of LiNiO_2 material for lithium secondary batteries

Sulfur 음이온 도핑에 의한 LiNiO_2 양극활물질의 전기화학적 특성 연구

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The layered lithium nickel oxide LiNiO_2 has been drawing much attention as a promising cathode material for lithium secondary batteries because of its comparatively low cost, large theoretical capacity (275 mAh/g), and environmental advantages over LiCoO_2 . However, LiNiO_2 has some severe problems such as low discharge capacity (about 140-150 mAh/g) due to the difficulty in the synthesis of stoichiometric LiNiO_2 and capacity fading due to the formation of NiO_2 phase by the phase transition of LiNiO_2 structure during intercalation/deintercalation of lithium ion.

In this work, we have synthesized sulfur doped nickel oxide compounds and investigated the effect of sulfur-doping on the electrochemical performance. $\text{LiNiO}_{2-y}\text{S}_y$ compounds were synthesized by partial substitution of oxygen for LiNiO_2 with sulfur anion. The structural and electrochemical properties of the synthesized materials were investigated using various analytical techniques. LiNiO_2 powders were first synthesized by a sol-gel method and then doped with sulfur powders by a solid state reaction under the flow of oxygen to prepare $\text{LiNiO}_{2-y}\text{S}_y$ ($y = 0 \sim 0.3$) powders. The LiNiO_2 electrode showed a gradual decrease of discharge capacity with cycle number, the capacity retention rate of $\text{LiNiO}_{2-y}\text{S}_y$ electrodes significantly improved. The initial capacity of the $\text{LiNiO}_{2-y}\text{S}_y$ cells was lower than that of LiNiO_2 cell and decreased with increasing the content of sulfur doped in $\text{LiNiO}_{2-y}\text{S}_y$. LiNiO_2 powders were also doped with sulfur using Li_2S powders to investigate the effect of sulfur source. The effect of the amount of sulfur used in the synthesis of $\text{LiNiO}_{2-y}\text{S}_y$ compounds were examined to improve the LiNiO_2 electrode performance.