The Effect of Large Surface Area Nickel On The Cycle Life of
Sulfur Cathode for Lithium / Sulfur Battery

Sang-Cheol Han [a], Hyun-Suk Kim [a], Yong-Mook Kang [a],
Hyo-Jun Ahn [b] and Jai-Young Lee [a]

[a] *Department of Materials Science and Engineering, KAIST, Republic of Korea*

[b] *Department of Metals & Materials, Gyeong-Sang National University, Republic of Korea*

Abstract

Elementary sulfur has the critical problem of poor cyclic behavior in spite of its high theoretical capacity (1,672mAh/g-sulfur) as a positive material for all rechargeable lithium sulfur battery system. It is clearly seen that the discharge capacity of elementary sulfur cathode decreases rapidly with increasing cycle number. Only after 30 cycles, 97 % of its initial discharge capacity is lost. In order to improve the cycle life of the sulfur cathode, a filamentary type nickel current collector is adopted as a catalyst for the redox reaction. Sulfur powder is ball milled with filamentary type nickel powder under Ar atmosphere. Sulfur of 0.2g (10wt.%), filamentary type Ni of 0.4g (20wt.%) and acetylene black of 0.2g (10wt.%) have been weighed and ball-milled in use of a ball-milling machine “Spex-8000 Mixer/Mill” for 20 minutes under argon atmosphere. A new nickel sulfide (NiS) phase is formed after ball-milling elementary sulfur with filamentary type nickel. The filamentary type nickel is very effective in improving the cycle life of elementary sulfur cathode. The filamentary type nickel ball milled sulfur shows an excellent cyclic property. It retained 99 % of its initial capacity after 110 cycles. It is suggested that the discharge mechanism is changed by the catalytic nickel sulfide phase and promote the redox reaction. There are three discharge potential plateaus (1.8V, 1.7V, and 1.5V) and also three charge potential plateaus at first charge-discharge cycling. The main long discharge potential is shifted from 2.0V to 1.5V.

Reference

[1] R.D. Rauh, K.M. Abraham, G.F. Pearson, J.K. Surprenant, and S.B. Brummer, *J. Electrochem. Soc.*, 126, 523 (1979).

[2] H. Yamin and E. Peled, *J. Power Sources*, 9, 281 (1983).

[3] D. Marmorstein, T.H. Yu, K.A. Striebel, F.R. McLarnon, J. Hou, E.J. Cairns, *J. Power Sources*, 89, 219 (2000).