

## Direct Carbon-Black Coating on LiCoO<sub>2</sub> Cathode using Surfactant for High-Density Li-Ion Cell

Jaephil Cho,<sup>1,\*</sup> Byoungsoo Kim,<sup>2</sup>  
Joon-Gon Lee,<sup>2</sup> & Byungwoo Park<sup>2,\*\*</sup>

<sup>1</sup>Department of Applied Chemistry,  
Kumoh National Institute of Technology,  
Gumi, Korea

<sup>2</sup>School of Materials Science and Engineering, &  
Research Center for Energy  
Conversion and Storage,  
Seoul National University, Seoul, Korea

Sales of Li-ion cells have been rapidly expanding due to the increase in end-users' demand for mobile electronics, such as notebook-PCs, PDAs, mobile phones, camcorders, etc. The total sales of these cells in 2002 have been reported to be over 6.5 billion dollars, and are expected to be more than 10 billion dollars in 2005. The capacity of Li-ion cells has also been increasing by over 7% every year, along with a decrease in cell thickness. While this is very challenging, it is only possible by means of changing the cathode material with a larger particle-size distribution, a smaller weight portion of the binder and conducting agent in the composite cathode, and thinner electrode substrates of Al and Cu. Currently, most cathode electrodes in Li-ion cells consist of 2 wt. % carbon black and a binder, respectively, and 96 wt. % of the cathode material. Therefore, the only solution to increasing the cell capacity is to replace the electrode materials with higher capacities, or to blend those materials with either LiCoO<sub>2</sub> or graphite. Several candidates such as LiNi<sub>1-x-y</sub>Mn<sub>x</sub>Co<sub>y</sub>O<sub>2</sub> for the cathode, and SnO<sub>2</sub> or Si for the anode have been proposed, but the overall power of the cell was lower due to a lower working voltage.

Surfactants consist of hydrophobic (water hating) and hydrophilic (water liking) groups, and the surfactant head group (S) and inorganic precursors (I) can be templated by electrostatic interactions, such as coulomb interactions, hydrogen bonding, and covalent bonding [1,2]. However, very limited amount of surfactants can be used in Li-ion cells, because the surfactants used in Li-ion cells must be dissolved in a solvent, and those with Na<sup>+</sup> or K<sup>+</sup> ions should be excluded so they can be removed by filtering.

In this presentation, we will present the effect of a direct carbon-black coating on the cathode using an amphoteric gelatin surfactant to fabricate a high-density Li-ion cell. By this technique, the volumetric density and rate capability were improved without sacrificing the cycle life, compared to the conventional Li-ion cell using bare LiCoO<sub>2</sub>.

### References

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2. E. D. Goddard and K. P. Ananthapadmanabhan eds., *Interactions of Surfactants with Polymers and Proteins*, CRC Press, Florida (1993).

\* jpcho@kumoh.ac.kr

\*\* byungwoo@snu.ac.kr