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Electrochemical Properties of Lithium-Sulfur Cells in a Very Wide Range of Sulfur Concentration

[Tae Jeong Kim](#)

Department of Chemical Engineering, Korea University of Technology and Education (KOREATECH), Cheonan 330708, Republic of Korea

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[Jeong Yoon Koh](#)

Department of Chemical Engineering, Korea University of Technology and Education (KOREATECH), Cheonan 330708, Republic of Korea

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[Hye Jeong Yang](#)

Department of Chemical Engineering, Korea University of Technology and Education (KOREATECH), Cheonan 330708, Republic of Korea

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[Yongju Jung](#)

Corresponding Author

E-mail address: yjung@koreatech.ac.kr

Department of Chemical Engineering, Korea University of Technology and Education (KOREATECH), Cheonan 330708, Republic of Korea

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[Tae Jeong Kim](#)

Department of Chemical Engineering, Korea University of Technology and Education (KOREATECH), Cheonan 330~f~Å,~Å€~Å,~Å•708, Republic of Korea

[Search for more papers by this author](#)

[Jeong Yoon Koh](#)

Department of Chemical Engineering, Korea University of Technology and Education (KOREATECH), Cheonan 330~f~Å,~Å€~Å,~Å•708, Republic of Korea

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[Hye Jeong Yang](#)

Department of Chemical Engineering, Korea University of Technology and Education (KOREATECH), Cheonan 330~f~Å,~Å€~Å,~Å•708, Republic of Korea

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[Yongju Jung](#)

Corresponding Author

E-mail address:yjung@koreatech.ac.kr

Department of Chemical Engineering, Korea University of Technology and Education (KOREATECH), Cheonan 330~f~Å,~Å€~Å,~Å•708, Republic of Korea

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Abstract

This paper examines the influence of the sulfur concentration on the electrochemical properties of $\text{Li}_2\text{S}/\text{S}$ cells over a very wide sulfur concentration range of 1.5 to 14.2 *m*. The sulfur utilization decreased gradually from 74 to 40% with increasing sulfur concentration in this concentration range. Surprisingly, the $\text{Li}_2\text{S}/\text{S}$ cells successfully operated with a considerable capacity (675 mAh/g) even under an extremely high sulfur concentration of 14.2 *m*. At a high rate of 5.0 C, the cells with 9.8 and 11.5 *m* sulfur showed much poorer rate capabilities than those with 2.3 and 5.6 *m* sulfur. This feature was attributed mainly to the significant ohmic drop and large reaction overpotential due to chemical reactions coupled with the electrode reactions of sulfur and polysulfides. In addition, there was a notable variation in the cycle performance with a change in the sulfur concentration. Interestingly, higher capacity retention was observed in 5.6 and 9.8 *m* sulfur than in low (2.3 *m*) and high (11.5 *m*) sulfur concentrations.

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```