The Study of Electrolytes for Li-Air Batteries

N. Kwon[1], Y. Sheima[1], K. M. Fromm[1]*

[1]University of Fribourg

Rechargeable lithium-air batteries potentially provide higher energy densities than the conventional rechargeable batteries due to the redox combination of light lithium metal anode and oxygen cathode. However, the redox reversible reactions and cyclability of those batteries remain a challenge. Among the possible set-ups of Li-air batteries, using an aqueous electrolyte provides a higher efficiency and cyclability due to the high ionic mobility and the solubility of discharge products [1]. However, water must not contact the lithium metal anode to avoid a violent reaction, producing heat and gas evolution. Thus, we apply an organic electrolyte on the lithium anode to protect the metal and an aqueous electrolyte on the cathode side to allow reversible electrochemical reactions. Another scientific issue is that during discharging, the value of pH increases due to the formation of LiOH, which damages the membranes [2,3] and leads upon saturation to LiOH precipitation [4]. Therefore, suppressing high pH in an aqueous electrolyte is a key parameter to improve the redox reversible reactions.

The solubility of O_2 in a mild pH of the aqueous solution was studied by adding H_3PO_4 in a half cell Li-air system. Fig. 1 shows the comparison of redox reactions in aqueous and organic electrolytes using different salts in Ar and O2 atmosphere. In case of using organic electrolyte, the oxidation current intensity was affected by the lower limit voltage. The further discussion will be presented in the conference.

[1] X. Wang, Y. Hou, Y. Zhu, Y. Wu, R. Holze, Nature **2013**, 3, 1401.
[2] D.J. Lee, O. Yamamoto, D.-M. Im, Y. Takeda, N. Imanishi, **2012**, Patent Application No. 13/191769.
[3] J. Christensen, P. Albertus, R. S. Sanchez-Carrera, T. Lohmann, B. Kozinsky, R. Liedtke, J. Ahmed, A. Kojic, *J. Electrochem. Soc.* **2012**, *159*, R1-R30.
[4] Y. Wang, H. Zhou, *J. Power Sources* **2010**, *195*, 358-361.