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Electrolyte chemistry of Mg rechargeable batteries

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Mg is earth abundant and low-cost (ca. 24 times cheaper than Li), and as an anode material, Mg is safe to use without dendrite formation (vs. Li, Li-ion, or Na-ion batteries). Its high gravimetric capacity (2,333 Ah/kg) and high reduction potential (-2.37 V vs. SHE) allow the assembly of high-energy density batteries. However, despite rapid research progress, the lack of high performance Mg^{2+} conductive electrolytes still presents a primary technical hurdle for developing practical Mg batteries. The presentation will cover our research efforts in developing high performance Mg electrolytes for Mg rechargeable batteries. Specifically, we will present the synthesis and electrochemical performance of ternary $Mg/MgCl_2/AlCl_3$ (MMAC) electrolytes and other Mg electrolytes. For example, the MMAC electrolyte in DME exhibit 100% Coulombic efficiency, and 164 mV ovpotenail for Mg deposition, and 3.7 V vs. Mg anodic stability. Solution and interfacial chemistry of the presented Mg electrolytes will be discussed in detail. In addition, we will share our results on applying advanced Mg electrolytes in developing high energy density Mg rechargeable batteries. Our preliminary data showed that Mg/S batteries using the MMAC electrolyte could deliver 800 mAh/g capacity at a rate of 100 mAh/g.

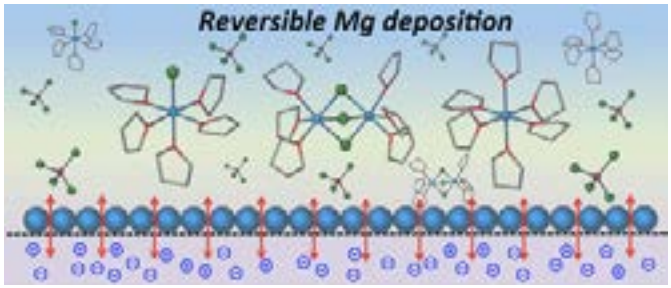

Figure 1

Recent Publications

1. Luo J, He S and Liu T L (2017) Ternary $Mg/MgCl_2/AlCl_3$ inorganic Mg^{2+} electrolytes with unprecedented electrochemical performance for reversible Mg deposition. 2:1197-1202.
2. He S, Luo J and Liu T L (2017) $MgCl_2/AlCl_3$ Electrolytes for reversible Mg deposition/stripping: electrochemical conditioning or not? Journal of Materials Chemistry A 5:12718-12722.
3. He S, Neilson K V, Luo J and Liu T L (2017) Recent advances on $MgCl_2$ based electrolytes for rechargeable Mg batteries. Energy Storage Material 8:184-188.
4. Liu T, Cox J, Hu D, Deng X, Hu J, Hu M, Xiao J, Shao Y, Tang K and Liu J (2015) A fundamental study on the [(u-Cl)3Mg2(THF)6]+ dimer electrolytes for rechargeable mg batteries. Chemical Communications 51:2312-2315.
5. Liu, T, Shao Y, Li G, Gu M, Hu J, Xu S, Nie Z, Chen X, Wang C and Liu J (2014) A facile approach using MgCl2 to formulate high performance Mg2+ electrolytes for rechargeable Mg batteries. Journal of Materials Chemistry A 2:3430-3438.

Biography

Tianbiao Leo Liu has received his PhD from Texas A&M University in 2009, served as Staff Scientist at Pacific Northwest National Laboratory from 2013 to 2015, and is currently an Assistant Professor at Utah State University. His research is broadly spread on energy and green chemistry including electrocatalysis, electrochemical energy storage, and environmentally benign chemical transformations.

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