

Effect of salts on the electrochemical performance of Mg metal–organic battery

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Development of Mg batteries is connected with two fundamental challenges, first is the incompatibility of Mg metal anode with solvents and salts used in the Li-ion battery electrolytes, and second is the lack of suitable cathode materials. Recent years, have seen quite a significant improvement through the development of several new Mg electrolytes with improved electrochemical properties (high oxidative stability, non-nucleophilic and non-corrosive), while the progress on the cathode side remains more elusive.

Organic cathode materials offer a possibility to circumvent issues connected with difficult intercalation and slow solid state diffusion of Mg cations inside the inorganic hosts. However, their application was until a few years ago limited by incompatibility between the organic compound, which often contain electrophilic centers, and nucleophilic Mg electrolytes. Our group was one of the first to combine non-nucleophilic Mg electrolytes with organic cathodes, which enabled us to achieve long-term cycling of Mg–organic battery.¹

Herein, we apply two Mg electrolytes based on simple and commercially available salts (MgCl_2 , $\text{Mg}(\text{TFSI})_2$ and AlCl_3) and combine them with the state-of-the-art organic cathode, polyanthraquinone (PAQ). Mg–PAQ cells were cycled for 500 cycles at 1C rate, after cycling the Mg anode morphologies were examined using scanning electron microscopy. To benchmark the capacities of PAQ cathodes in Mg electrolytes, they were referenced with PAQ electrochemical performance in Li battery setup. Comparison of the capacities revealed beneficial effect of $\text{Mg}(\text{TFSI})_2$ - 2MgCl_2 electrolyte on maximum obtainable capacity and capacity fade in comparison with MgCl_2 - AlCl_3 . The maximum obtainable capacity in $\text{Mg}(\text{TFSI})_2$ - 2MgCl_2 is 75% of the maximum capacity in Li and final discharge capacity after 500 cycles is 111 mAh/g.

References

1. Bitenc, J.; Pirnat, K.; Bančič, T.; Gaberšček, M.; Genorio, B.; Randon-Vitanova, A.; Dominko, R. Anthraquinone-Based Polymer as Cathode in Rechargeable Magnesium Batteries. *ChemSusChem* **2015**, 8 (24), 4128–4132.