Chapter 4
Conclusion

The ultimate post-lithium-ion battery will contain a metallic anode. However, since the use of lithium metal anode has been precluded due to the dendritic nature of its electrodeposition, there has been a rush for alternative, non-dendritic metal anodes. Magnesium has been shown to electroplate smoothly, without dendrites, and champions the race toward a post-lithium-ion battery with a safe metallic anode. Progress in magnesium electrolytes has been marked by the successful transition from low-voltage stability electrolytes used for electroforming toward high-voltage, noncorrosive electrolytes used in rechargeable magnesium batteries. Modern magnesium electrolytes have high oxidative stabilities in excess of 4 V vs. Mg/Mg^{2+}, are not corrosive, have high conductivities of 5–10 mS/cm, and are compatible with metallic magnesium anodes. The current challenge in this field is the ease of synthesis and transferability of electrolytes and their synthetic routes for wide access by the community. The last piece of the rechargeable magnesium puzzle is a cheap, stable, high-energy cathode. While great progress has been in done in recent years, it is still difficult to pair a cathode with a voltage >1.5 V vs. Mg/Mg^{2+} with a magnesium metal anode. In addition, while reported rates of operation are rapidly improving, they are still lower than those of lithium cathode counterparts. So far, high-capacity conversion cathodes such as selenium, sulfur, or iodine outcompete intercalation cathodes which are plagued by low voltage and low capacity. Important progress in the area of noncorrosive high-voltage electrolytes and high-energy cathodes with high cycle life suggests that the future of a rechargeable magnesium battery looks brighter than ever. Research focus on easy synthetic routes for high-voltage electrolytes will ensure that a commercially viable cathode will be soon discovered. Such a breakthrough will undoubtedly improve the quality of life for all mankind.

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