Lithium Polymer Cells assembled with Gel Polymer Electrolytes cured by Reactive Ceramic Particles

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Rechargeable lithium batteries using lithium metal as a negative electrode are receiving significant research interest, because the lithium electrode offers a very high specific capacity (3,860 mAh g^{-1}), which is more than ten times that of the currently used carbon electrode. However, the use of lithium metal electrode has been limited by the occurrence of dendrite growth during repeated charge and discharge cycles, since it gives rise to safety problems and gradual degradation of cycling efficiency. In our previous studies, the lithium powder instead of lithium foil was suggested as a new anode material to prevent dendrite growth, and it was demonstrated that the electrochemical properties and safety of lithium powder electrodes could be improved [1,2]. There is a pressing need for safer, more reliable electrolyte systems for the successful development of lithium metal batteries. At present, gel polymer electrolytes are considered as one of safe electrolytes to substitute for liquid electrolytes used in lithium batteries. As a type of gel polymer electrolytes, chemically cross-linked gel polymer electrolytes could be synthesized by in-situ cross-linking reaction of liquid electrolyte with cross-linking agents. In this study, we synthesized the reactive ceramic particles containing vinyl groups [3], which permit the in-situ chemical cross-linking with electrolyte precursor containing monomer or cross-linking agent. The lithium metal polymer cells composed of a lithium powder anode, a cross-linked gel polymer electrolyte and a LiV_3O_8 cathode, were assembled and their cycling performance was evaluated. In this process, an electrolyte solution containing cross-linking agents is injected into the cell, and gelation is carried out by heating the cell, which resolves the leakage problem while maintaining good thermal and dimensional stability as well as high ionic conductivity. The proper amount of the reactive ceramic particles to achieve good cycling performance will be suggested.

References

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