Organic Radical Battery

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The organic radical battery is a new type of lithium-ion battery which is attractive as an environmentally friendly, high power, high energy density rechargeable battery. In this battery, polyradicals are used instead of transition-metal oxide as an active material in cathodes. Here we describe battery performance characteritics for organic radical batteries using poly (2,2,6,6-tetramethylpiperidine-N-oxyl-4-yl methacrylate) (PTMA) as a cathode active material (Fig. 1).

Organic radical batteries were fabricated through modification of the method used to make a lithium-ion battery (Fig.2). Both lithium metal and a graphite intercalation compound were applied as anode active materials for the organic radical battery. Carbonate into which lithium salt had been dissolved was used as the electrolyte solution.

The initial specific capacity of PTMA was found to be 60-100 mAh/g. This value is correlated with the radical density (radical/unit) of the polyradical (PTMA). The cycle ability of a PTMA electrode is quite good (92% after 1000 cycles), but the cycle ability of organic radical battery depends on that of the anode material(Fig. 3). For a 100-□m-thick PTMA composite cathode, we were able to obtain sufficient capacity at a discharge current density between 1-10 mA/cm^2 (Fig. 4). By optimizing the dispersion of PTMA and the cathode composition, we were able to improve the high-power property of the cell. In conclusion, the organic radical battery has the potential to become a practical rechargeable battery, especially for high-power applications.

Acknowledgments

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References

[1] K. Nakahara, S. Iwasa, M. Satoh, Y. Morioka, J. Iriyama, M.Suguro and E. Hasegawa, *Chem. Phys. Lett.*, **359**. 351-354 (2002).

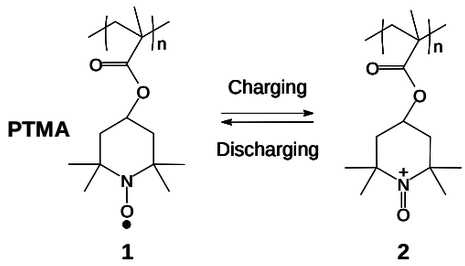

Fig. 1 Electrochemical reaction of PTMA

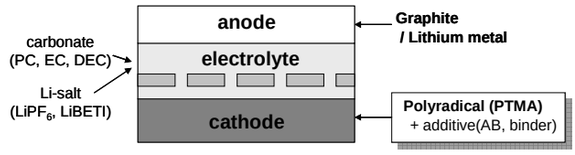

Fig. 2 Schematic illustration of Organic radical batteries.

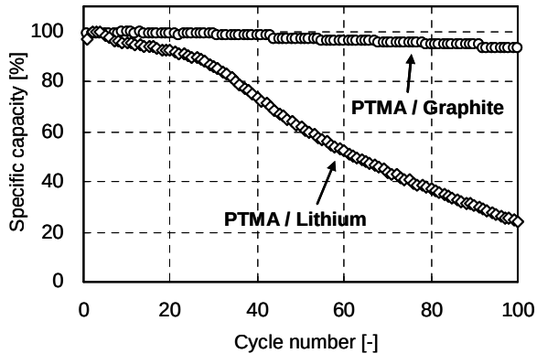

Fig. 3 Cycle ability for an organic radical battery

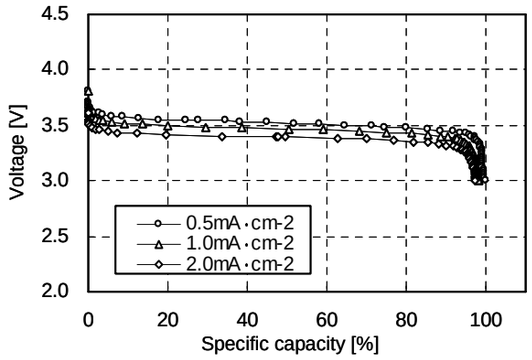

Fig. 4 Discharge curves at various current densities for a PTMA/Li cell