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NEXT GENERATION LI-ION BATTERIES WITH HIGH SPECIFIC ENERGY FOR SPACE APPLICATION

Abstract

Li-ion batteries offer many advantages over technologies traditionally used in space application, such as silver-zinc and lead acid batteries. The superior capabilities of Li-ion batteries include the higher specific energy, the longer calendar life and the low maintenance. The state-of-the-art Li-ion batteries include LiCoO2/graphite and NCA/graphite batteries for the space application. The next-generation Li-ion batteries will provide power systems with significant mass and volume savings, increased efficiency and enable operation at wide temperatures and extreme radiation environments. These advanced capabilities will enable energy storage for future exploration missions such as: missions using electric propulsion, lunar exploration missions, astronaut equipment, and distributed constellations of micro-spacecraft. However, the highest specific energy reached only 168 Wh/kg for SAFT. Hence, advanced batteries are required for a number of future space missions above. At 16th IMLB, the 45Ah soft-packed cell of 430 Wh/kg was prepared with HCMR cathode and Si-C composite anode. Besides, the target of NASA's energy storage for space missions is 400 Wh/kg for the secondary cells at 2020. In our institute, the key components were investigated to develop the next-generation high specific energy Li-ion batteries for the future space application. The layered Li-rich cathodes with Li2MnO3 and LiMO2 (M=Mn, Ni, Co et al) have become as the promising cathode materials for the next-generation high specific energy Li-ion batteries due to the high capacity of around 250 mAh/g with a lower cost and better safety in comparison with LiCoO2. With the polyacrylamide-assisted carbonate co-precipitation method, the capacity of the cathode was 271 mAh/g with 85The Si-based composites were synthesized by ball milling SiO powder, graphite powder and coal tar pitch. The specific reversible capacity of the sample reached 1100 mAh/g at 50mA/g current. This capacity is over three times than that of high-performance graphitic anodes. The objective of the electrolyte development effort is to develop non-flammable or flameretardant electrolytes that are stable up to 5 V while maintaining electrochemical performance. To achieve this, different electrolyte formulations are combined with additives that have the capability to improve high voltage stability. On the basis of the above results, the high specific energy soft-packed Li-ion cells of 260 Wh/kg with Li-rich cathode/graphite were prepared. The further investigations,such as the cycle life, safety et al, will be carried out in the future work.