In-situ X-ray analyses of layered double hydroxides for high performance aqueous rechargeable battery

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Increasing demand for energy storage systems that guarantee safety and cost-competitiveness promotes aqueous rechargeable batteries (ARBs) as one of the most promising energy storage systems. Yet, it is still difficult to find out a material capable of operating within the limited electrochemical window of aqueous electrolytes in a robust manner.

In this symposium talk, researches on ARBs using layered double hydroxides (LDHs) will be introduced. In-situ X-ray diffraction and absorption analyses revealed that the charge storage mechanism of LDH is different from the β phase counterpart. Crystal water, as a product of the charging process, is re-arranged into a superlattice pattern in the LDH host framework. Since this superlattice arrangement of crystal water molecules can effectively alleviate the lattice distortion, a full cell battery paired with Fe_3O_4 anode, exhibited an operating voltage of 1.1 V with high capacity (198 mAh/g), high power capability (172 mAh/g@1min) over 10,000 cycles. When replacing Fe3O4 with Zn, the LDH-based full cell exhibited high working voltage up to 1.7 V.