

Nanoparticle Iron-Phosphate Anode with a New Crystal Structure for a Li-Ion Battery

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Up to now, iron phosphates have been explored as cathode materials only.¹⁻³ Padhi *et al.* reported an olivine-type LiFePO₄ cathode, which has a theoretical capacity of 170 mAh/g. As lithium is intercalated/deintercalated from the octahedral sites, olivine-type LiFePO₄ has a flat voltage plateau at 3.4 V vs. Li. In addition, iron phosphates exhibited different types of structures depending on the synthesis conditions. For instance, FePO₄ showed a trigonal structure at normal pressure, but converted to orthorhombic structure at high pressure.⁴ More recently, Song *et al.*⁵ and Reale *et al.*⁶ reported monoclinic (with a space group *P2₁/n*), orthorhombic (with *Pbca*), or hexagonal (with *P6₃mc*) FePO₄. These iron phosphates exhibited an open-circuit voltage of approximately 4 V, and showed a voltage plateau at ~3 V (working as cathodes) with discharge capacities below 100 mAh/g.

We report here a new possibility of iron phosphates as anode materials for Li rechargeable batteries. Despite iron phosphates being briskly investigated as a positive electrode, the anode materials of FePO₄ have not been reported in the open literature yet. The capacity of synthesized nanoparticle iron phosphates is approximately 3 times higher than the ideal capacity of the LiFePO₄ cathode.

References

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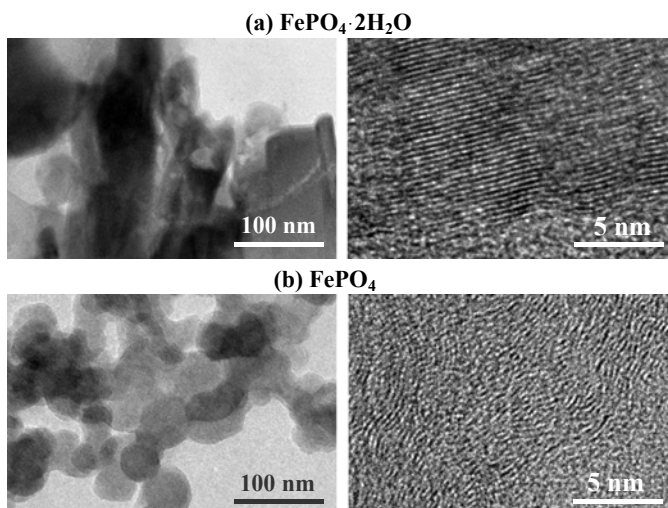


Figure 1. High-resolution TEM images of the iron phosphate: (a) as-synthesized FePO₄·2H₂O, and (b) FePO₄ (annealed at 400°C for 8 h).

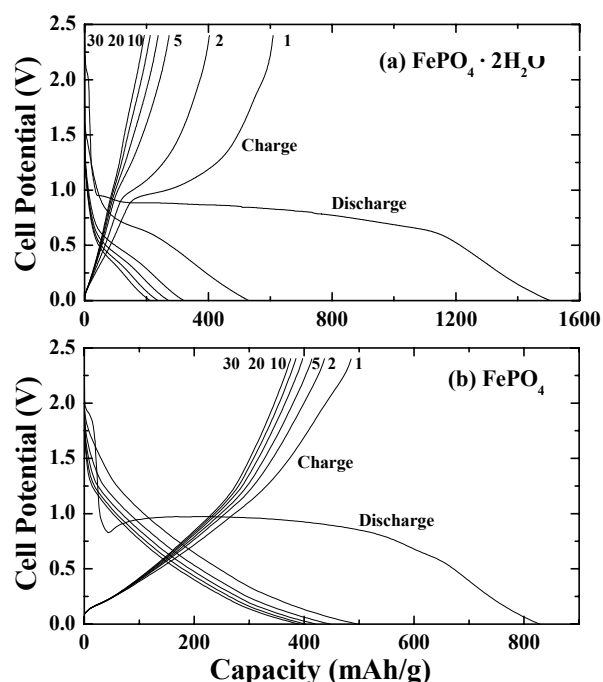


Figure 2. Voltage profiles of the iron phosphates between 2.4 and 0 V. The cells were cycled at (a) 61 mA/g for variscite FePO₄·2H₂O (initial capacity of 609 mAh/g), and (b) 49 mA/g for tridymite FePO₄ (initial capacity of 485 mAh/g).

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