# The Delayed Structural Transformation for the $LiFePO_4$/C during Charging and Discharging at a Lower Rate

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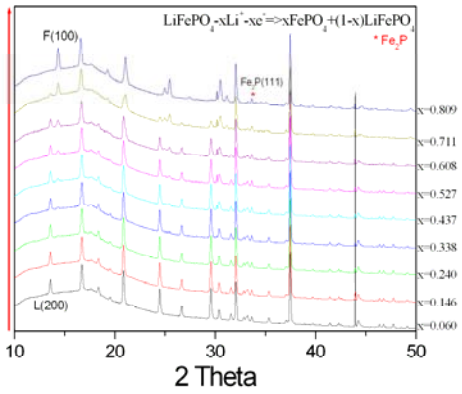
Figure 1 describes the in-situ synchrotron X-ray diffraction patterns of the $LiFePO_4$/C synthesized at 800°C during charge and discharge at 0.25C. The reflection peaks, associated with the $Fe_2P$ impurities as the inactive material, were exhibited at 33.6°. The $LiFePO_4$/C synthesized at 800°C had lower discharging capacity of 135 mAh/g than that synthesized at 750 °C at the rate of 0.25C. The lower discharging capacity was affected by a large amount of the $Fe_2P$ impurities. The negative effect of $Fe_2P$ is not yet well known, nevertheless, Song et al. inferred that the formed $Fe_2P$ above the critical concentration disrupted the one-dimensional $Li^+$ pathways followed by hindraning $Li^+$ transport [1]. However, the $LiFePO_4$/C synthesized at 800°C presented a normal structural transformation process, which was due to the existence of $Fe_2P$ impurities. The impure $Fe_2P$ phase with metallic conductivity of 1.5 S $cm^{-1}$ significantly improved the electronic conductivity of the $LiFePO_4$ from $10^{-9}$ to $10^{-3}$ S $cm^{-1}$ [2]. The $Fe_2P$ particles might play an important role in affecting the nucleation sites. According to the above-mentioned arguments, the produced $Fe_2P$ phase would disturb the structure of the $LiFePO_4$. It was reported that the transportation of Li ions took place near the phase boundary through supplying the activation energy for nucleation [3]. Therefore, the disordered structure, resulted from the $Fe_2P$ phase, possessed more regions with higher energy to stimulate the intercalation and deintercalation of Li ions. Furthermore, the enhanced electronic conductivity of $Fe_2P$ also improved the electron flow to speed the phase transformation.

(a)




(b)

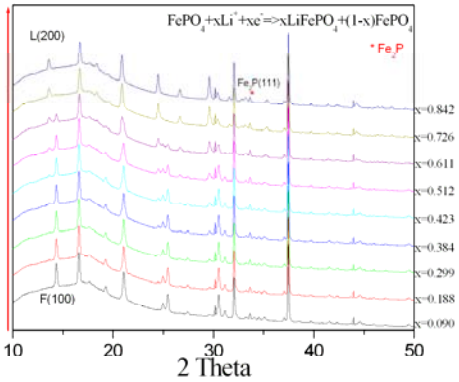



**Fig. 1:** In-situ X-ray diffraction patterns of $LiFePO_4$/C synthesized at 800°C (a) charge and (b) discharge at 0.25C (λ=1.334 Å). The subscripts L and F represent reflections of $LiFePO_4$ and $FePO_4$ structures.

References

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[3] C. Delmas, M. Maccario, L. Croguennec, F. Le Cras, and F. Weill, Nature mater. **7**, (2008).