Interaction of carbon coating on $LiFePO_4$: Local visualization study of the influence of impurity Phases

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As a well-known positive material for lithium ion batteries, $LiFePO_4$ has attracted increasing attention in both academic and industrial communities due to its highly thermal stability[1,2] The main drawback of this material is its poor intrinsic electrical conductivity, which can be overcome by using thin layer carbon coating on nanosized $LiFePO_4$ and has been successfully commercialized. Carbon coating has been proven to be a successful approach to improve the conductivity of $LiFePO_4$ used in rechargeable Li-ion batteries. However, little attention has been paid to the understanding of nanocarbon coating especially the interaction of nanocarbon coating on $LiFePO_4$.

Here, we present direct experimental evidences about the interaction of carbon coating on $LiFePO_4$, specially a local visualization study of the influence of impurity phases on carbon coating, which are investigated on a model material with various nano characterization techniques. By using the ingot sample with a flat surface as model materials, impurity phases can be clearly observed, identified, and located on the surface of the sample by scanning electron microscope (SEM), Focused ion beam Lithography (FIB) (*The Western Nanofabrication Facility*), High-resolution transmission electron microscopy and micro Raman mapping techniques.

Our results indicated that the phosphorus-rich phase is found to have an inhibiting effect (or no positive catalytic effect) on carbon formation while iron-rich phases (mainly iron phosphides) promote carbon growth by contributing to more carbon deposition and higher graphitic carbon content. This finding and the methodological evaluation here will help us to understand and reveal the influencing factors from impurity phases on basic carbon-deposition process and on obtaining high-performance $LiFePO_4$ material for future energy storage devices.

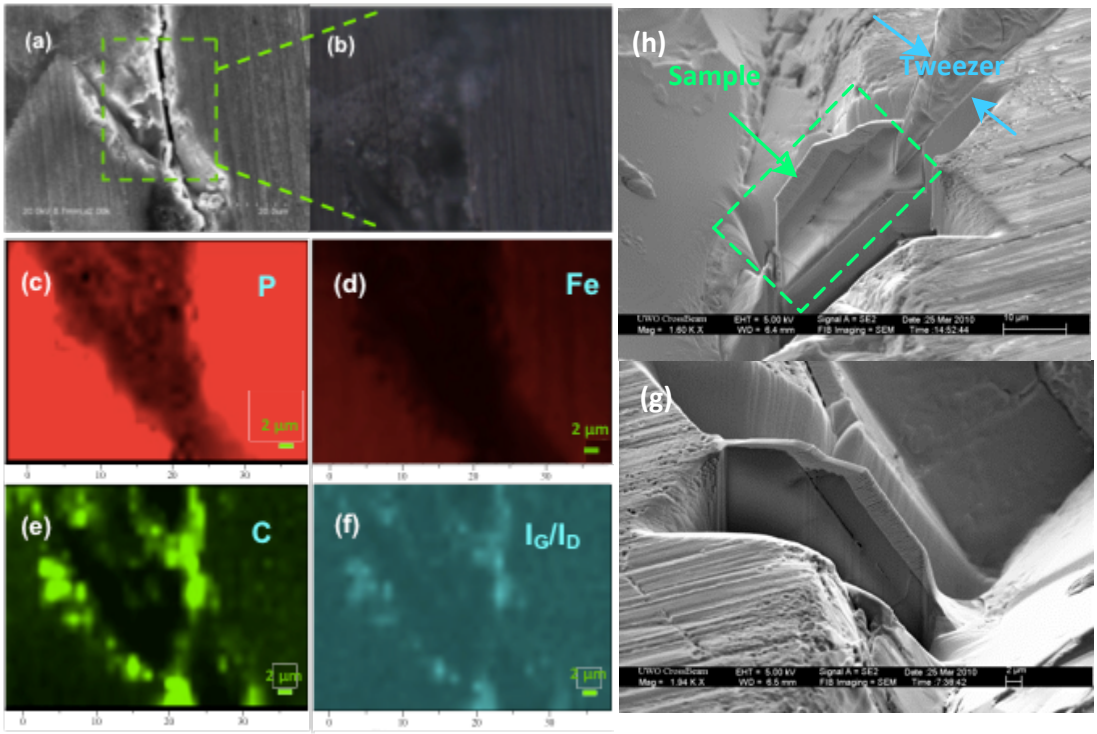

Figure. Micro-Raman mapping of the impurity (a-f) and FIB process (g-h) of the HRTEM sample

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2. Wang, J.; Sun, X. Energy Environ. Sci. 2012, 5, 5163-5185

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