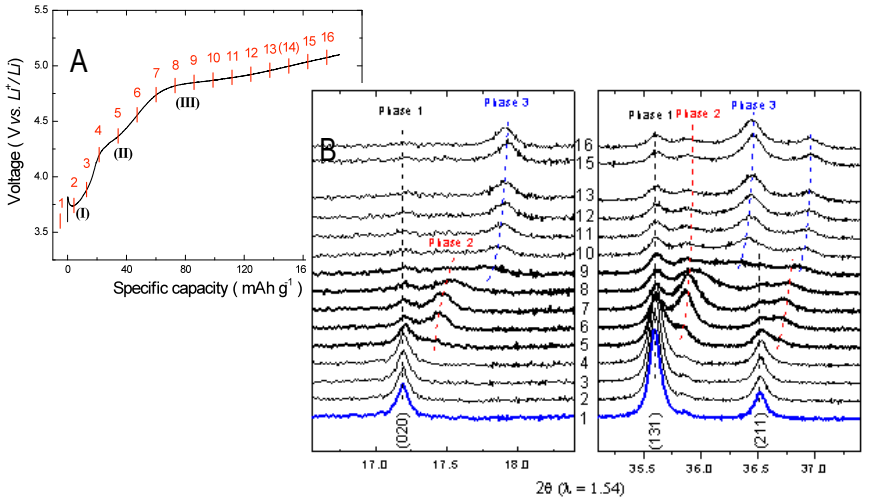
Powder Diffraction Beamline for *In Situ* Studies of Structural and Chemical Transformations (IXD)

IXD at NSLS-II

- As a powder diffraction beamline with medium x-ray energy, IXD will enable *in situ* XRD measurements with time scale of seconds and decent Q-space resolution, and is suitable for element selective and surface sensitive XRD methods.
- The state of art capabilities for *in situ* XRD measurements under various conditions will find broad applications in advanced energy material studies and industrial R & D.

Examples of Science Areas & Impact

- BATTERIES: The *in situ* XRD measurements on cathode and anode materials of Li-ion batteries make it possible to monitor the structural transformation during the charge-discharge cycles, help in understanding the electrochemistry process and the search for better materials for energy storage.
- FUEL CELLS: Grazing angle XRD to reveal the composition and morphology of the surface layers of the Ni-YSZ anode as applied in novel full cell design
- HIGH TEMPERATURE ALLOYS: *In situ* residual stress measurements under high temperatures on the surface and coating materials of high temperature alloys such as used in solid oxide fuel cell and gas turbines



(A) 1st charge curve of **C**-$LiFe_{1/4}Mn_{1/4}Co_{1/4}Ni_{1/4}PO_4$ **(B)** *In situ* XRD patterns of **C**-$LiFe_{1/4}Mn_{1/4}Co_{1/4}Ni_{1/4}PO_4$ during 1st charge. A partially delithiated solid solution phase (phase 2) is identified between the two normally observed end phases in $LiFePO_4$ cathodes. K Nam et al, Electrochem. Commun., 11, 913 - 916 (2009).

Beamline Capabilities

TECHNIQUE(S): *in situ* powder diffraction studies under high temperature, high pressure, reaction gas flow and charge-discharge cycles

SOURCE: three-pole wiggler

ENERGY RANGE / RESOLUTION: 6 to 25 keV / 1.3 x10^{-4}

BEAM SIZE: vertically ~ 200 μm , horizontally 0.2 to 2 μm

U.S. DEPARTMENT OF ENERGY

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