

## Redox orbital with Lithium intercalation in $\text{Li}_x\text{Mn}_2\text{O}_4$ and $\text{Li}_x\text{CoO}_2$

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Although spinel  $\text{Li}_x\text{Mn}_2\text{O}_4$  and  $\text{Li}_x\text{CoO}_2$  have been widely used as the cathode materials of Li-ion batteries, the fundamental electronic structures still remain a mystery. It has been believed that the charge compensation reaction is ascribed to redox of 3d orbitals of transition metals [1,2]. On the contrary other calculations suggest substantial electron transfer to oxygen 2p upon lithium intercalation in spinel  $\text{Li}_x\text{Mn}_2\text{O}_4$  [3] and  $\text{Li}_x\text{CoO}_2$  [4]. Our recent Compton scattering measurements for  $\text{Li}_x\text{Mn}_2\text{O}_4$  [5] and  $\text{Li}_x\text{CoO}_2$  suggest a substantial electron transfer to interstitial states with 2p oxygen like character and less localization of transition metal 3d electrons upon the lithium intercalation. These results require changing the story that Jahn-Teller-like distortions associated with  $\text{Mn}^{3+}$  ions occur with the lithium intercalation process for  $\text{Li}_x\text{Mn}_2\text{O}_4$ , for example, and may open a new criteria for designing cathode materials of Li-ion batteries.

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