Surface-Modified $Li_4Ti_5O_{12}$ Anode Materials for High-Power Li-Ion Batteries

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$Li_4Ti_5O_{12}$ (LTO) has been recognized as one of the most promising candidates for anode materials of high-power lithium-ion batteries owing to its ideal zero-strain property during Li-ion intercalation and de-intercalation process, superior cycling stability, and outstanding safety induced by a high voltage plateau around 1.55 V versus Li^+/Li. Thus, LTO has been developed mostly targeted for large appliances such as electric vehicles and energy storage systems. However, the main obstacles that impede widespread application of LTO are its poor electronic (10^{-13} S cm^{-1}) and ionic conductivities (10^{-8} S cm^{-1}). Typical cation doping has become an effective way to improve the electronic conductivity and structural stability of LTO; single or multi cation (Mg, V, Mn, Fe, Cr, Yr, Ru, etc.) doping on the Li^+ or Ti^{4+} sites in LTO lattice structure has been widely investigated. Meanwhile, the modified the oxygen structure in LTO crystal structure by replacing part of the O^{2-} sites with other anions enhanced the conductivity of LTO as well.

In the present work, differing from the previous studies, novel surface-modified $Li_4Ti_5O_{12-a}X_a$ (X = F, Cl) was obtained via a simple one-step solid-state reaction assisted by in-situ halogen gas. The effects of halogen elements (F, Cl) on the electrochemical properties of LTO will be also discussed.