

Investigation on the magnetic and Mössbauer spectroscopy of ^{57}Fe doped LiMnPO_4

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Keywords: Mössbauer spectroscopy, Cathode, Lithium-ion battery

Next generation LiMnPO_4 cathode has received attention as the most suitable replacement material owing to its high working voltage (4.1 V), low cost, environmental friendliness, and the abundance of Mn. The crystallographic and magnetic properties of $\text{LiMn}_{0.99}\text{Fe}_{0.01}\text{PO}_4$ were investigated by using X-ray diffractometer (XRD), vibrating sample magnetometer (VSM), and Mössbauer spectroscopy. The crystal structure of the sample is determined to be orthorhombic of $Pmn2_1$ with its lattice constants $a_0 = 6.1009$, $b_0 = 10.4435$, and $c_0 = 4.7427$ Å by Rietveld refinement. The zero field cooled (ZFC) and field cooled (FC) magnetization curves taken at 100 Oe for various temperatures were measured. The antiferromagnetic behavior was observed at 34 K, which was determined as Néel temperature. ZFC-FC curve showed an abnormal magnetic transition at 8 K, which is associated with the spin reorientation by spin-orbit coupling. The temperature dependence of magnetic inverse susceptibility ($1/\chi$) for $\text{LiMn}_{0.99}\text{Fe}_{0.01}\text{PO}_4$ was fitted by the Curie-Weiss law. Mössbauer spectra of $\text{LiMn}_{0.99}\text{Fe}_{0.01}\text{PO}_4$ were taken at various temperatures ranging from 4.2 to 295 K. The charge state of Fe ions is in ferrous (Fe^{2+}) for the sample. Magnetic hyperfine (H_{hf}) and electric quadrupole splitting (ΔE_Q) at 4.2 K have been studied, yielding the following results; $H_{\text{hf}} = 320$ kOe, $\Delta E_Q = 2.81$ mm/s. Also, we were performed the Mössbauer measurements with a high external field of 4.8 T.

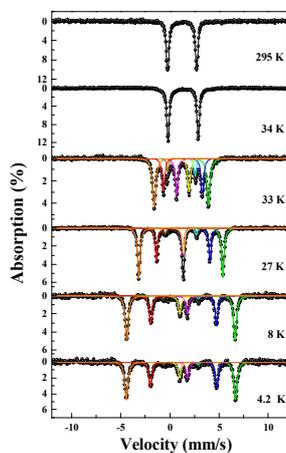


Fig. 5. Mössbauer spectra of $\text{LiMn}_{0.99}\text{Fe}_{0.01}\text{PO}_4$ at various temperatures.

Acknowledgments

This work was supported by the National Research Foundation of Korea (NRF) Grant funded by the Korea government (MEST)(NRF-2017R1A2B2012241).

