

## XRS study on 5V $\text{LiCr}_{0.08}\text{Ni}_{0.42}\text{Mn}_{1.50}\text{O}_4$ battery electrodes

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Here we report the study of the  $\text{LiCr}_{0.08}\text{Ni}_{0.42}\text{Mn}_{1.50}\text{O}_4$  cathode material by means of x-ray Raman spectroscopy at ESRF ID20 [1]. Li K-edge, Ni and Mn M-edges, as well as Ni L-edges were measured at various states of charge. We identify the nickel as the main actor in the charge compensation mechanism, showing how the initial  $\text{Ni}^{2+}$  state oxidise during the charge to  $\text{Ni}^{4+}$  through an intermediate state of  $\text{Ni}^{3+}$ . The theoretical calculation of the Ni L edge spectra confirm the interpretation of the experimental results. The complementary truly bulk-sensitive results reported here draw the attention on the ability of x-ray Raman spectroscopy as an useful tool for Li-ion battery studies.

### References

[1] - S. Huotari, Ch. Sahle, C. Henriquet, A. Al-Zein, K. Martel, L. Simonelli, R. Verbeni, H. Gonzalez, M.-C. Lagier, C. Ponchut, M. Moretti Sala, M. Krisch, G. Monaco: A large-solid-angle X-ray Raman scattering spectrometer at ID20 of the European Synchrotron Radiation Facility, *J. Synchrotron Radiat.* 24, 521 (2017).