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# P97 - Imaging of Li Distribution in Li ion batteries by direct elemental detection tecnique of PIGE and NRA combined with proton microbeam at TIARA

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The ion microbeam analysis is a powerful tool to characterise the distribution and the behaviour of specific elements in the three dimensional space in materials. For the development of advanced lithium ion batteries, especially for large scale applications such as vehicle and energy-storage uses, precise diagnostics of Li especially in the electrode material is strongly desired. The distribution of light elements, in particular Li in Li ion battery materials, have been characterized by combining nuclear reaction analysis (NRA) and particle induced gamma-ray emission (PIGE) techniques. NRA and PIGE measurements were carried out by using the $\{^7Li(p,\alpha)^4He\}$ and the $\{^7Li(p,p'\gamma)\}$ nuclear reactions, respectively. The characterization of other elements different than Li was simultaneously done, by using particle-induced X-ray emission technique (PIXE). Measurements were done at the the proton microbeam system with the spatial resolution of 1 µm at Takasaki Ion Accelerators for Advanced Radiation Application (TIARA) of Japan Atomic Energy Agency (JAEA). The Li distribution was analysed for specially fabricated electrode samples containing micro particles based on metal oxides such as $Li_xNi_{0.8}Co_{0.15}Al_{0.05}O_2$ ($0.75 \leq x \leq 1.0$) [1]. Although some other advanced Li- ion batteries cathodes materials were also investigated. The Li distribution is studied as a function of charge conditions and of materials parameters. This paper describes the analysis system dedicated to the Li-ion battery characterization and the main results of some of the experiments.

[1] K.Mima, R.Gonzalez-Arrabal, H.Azuma, A.Yamazaki, C.Okuda, Y.Ukyo, H.Sawada, K.Fujita, Y.Kato, J.M.Perlado, S.Nakai, Nucl Instrum Methods B290
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