The power of correlative techniques: Quantification of lithium using quantitative backscattered electron imaging and EDS

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Lithium- (Li-) based materials and products have gained significant commercial importance due to their widespread utilization in applications such as battery technologies and aerospace alloys. To understand and optimize properties of these materials, it is highly desirable to determine the elemental composition at the microscale quantitatively. However, commonly used elemental analysis techniques in the scanning electron microscope (SEM), like X-ray energy dispersive spectroscopy (EDS) and secondary ion mass spectroscopy (SIMS), are unsuitable for quantitative analysis of lithium. Recently, an alternative approach for quantitative evaluation of the Li content has been described using a composition-by-difference technique based on comparison of quantification (of non-lithium elements) by EDS and quantitative backscattered electron (qBSE) microscopy.

The state of the art for quantitative backscattered electron analysis (qBSE) and the composition by difference approach is presented. Further, its vital contribution together with EDS to quantitatively investigate in material systems such as lithium in cathode materials in the scanning electron microscope is discussed.

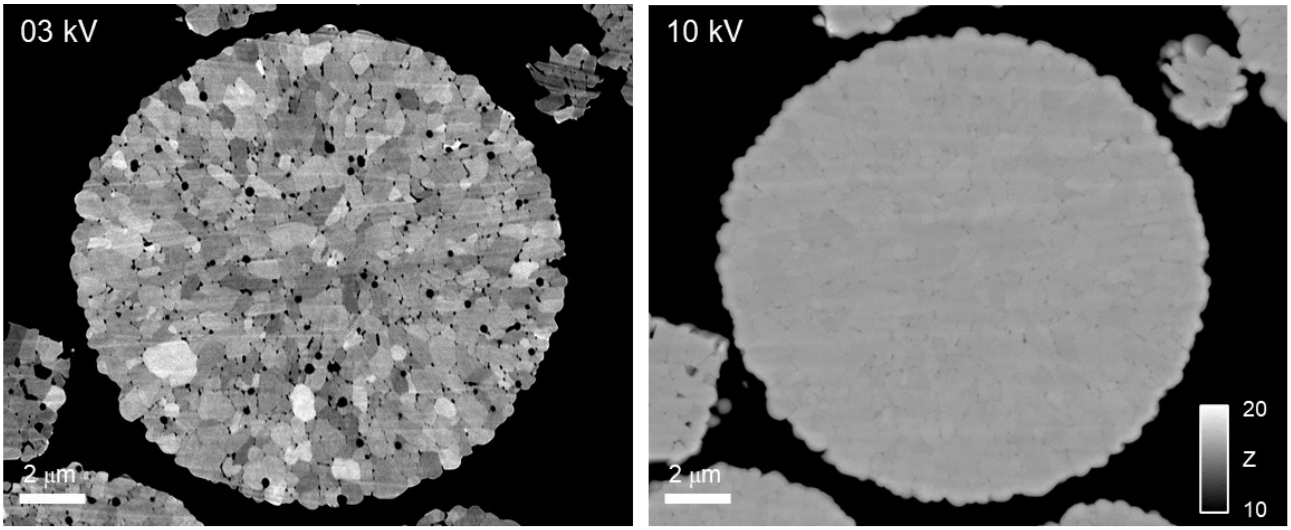

Fig. 2. Backscattered electron images of a (lithium) nickel manganese cobalt oxide particle. (Left) High contrast image revealing <10 nm primary particles; captured at low accelerating voltage (3 kV) to enhance contribution of channeling contrast. (Right) Mean atomic number (Z) image; captured at moderate accelerating voltage (10 kV); BSE signal proportional to mean atomic number.