

Detection of Li K Emission In Different Lithium Compounds

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Soft x-ray emission spectroscopy (XES) is a technique used to study the electronic structure of materials. It measures the energy spectrum of emitted x-rays from a sample. It is performed by irradiating the sample with ionizing particles (electrons in our case) and measuring the energy distribution of the x-rays that are subsequently emitted. The emitted x-rays are characteristic of the electronic states of the sample, thus, the presence of an element can be detected, and could be also used to perform quantitative analysis.

Reflection zone plates (RZP) can be used in XES as a wavelength-dispersive element [1]. They consist of a series of concentric zones, each with a slightly different thickness. When x-rays are incident on the zone plate, the different zones act as diffraction gratings, causing the x-rays to diffract and interfere with one another while focusing them at the same time. They have higher spectral resolution and cover wider energy ranges compared to other optical elements such as periodic multilayers. RZPs allow to the reach of energy resolutions as low as 0.49 eV at the Al L_{2,3} line (around 72 eV) [2]. With parallel detection of x-rays in contrast to conventional wavelength dispersive spectroscopy (WDS) spectrometers with a dispersive crystal (or multilayer) based on Rowland mounting they do not have a scanning mechanism.

In this work, we demonstrate the use of a Fresnel (RZP) implemented in an electron microprobe for the detection of Li K (around 50-55 eV) emission in different lithium compounds. Li K emission is a characteristic emission band produced when Li 1s levels are ionized inside the material. However, it can be challenging to detect this emission due to its low fluorescence yield, re-absorption effects, and the presence of other spectral lines in the same energy range. We report on our measurements of the Li K emission bands in several lithium compounds with an RZP spectrometer. Our results demonstrate this approach's potential for various applications in the field of x-ray spectroscopy.

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References

[1] A. Erko *et al.*, *Opt. Express*, vol. 22, no. 14, p. 16897, Jul. 2014, doi: 10.1364/OE.22.016897.

[2] A. Hafner *et al.*, *Opt. Express*, vol. 23, no. 23, p. 29476, Nov. 2015, doi: 10.1364/OE.23.029476.