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Multi-modal correlative microscopy: simultaneous and colocalised Raman & SEM imaging

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Multi-modal sample analysis is essential to thoroughly characterise and understand our samples and materials and ultimately conduct cutting edge science.

Here we focus on 4 different modalities: Raman spectroscopy, optical imaging, SEM (scanning electron microscopy) imaging and EDS (energy dispersive X-ray spectroscopy). These techniques allow us to determine chemical composition, molecular and crystalline structure (Raman spectroscopy), collect optical images, image samples at high resolution (SEM imaging) and determine elemental composition (EDS). When combined, these techniques provide an excellent toolbox for sample characterisation. Measurements were conducted using an inLux™ SEM Raman interface attached directly to the SEM microscope. This enabled colocalised and simultaneous SEM, Raman, and optical imaging inside the SEM chamber, making correlation between the three techniques trivial, without ever moving the sample.

Figure 1 illustrates SEM, EDS and Raman images taken from a mineral section, demonstrating a clear and accurate overlay between minerals found with three techniques. Additionally, the complementary potential of the multi-modal analysis showed species detected only with Raman (anatase) or EDS (Zn, sphalerite). The presence of anatase also shows that Raman spectroscopy is sensitive to the many polymorphs of TiO_2.

The application potential of correlative SEM and Raman imaging will also be demonstrated on batteries, polymeric and biological samples. With these examples, we illustrate how Raman and SEM can increase understanding of materials, and the power and ease of use when the techniques are combined inside a SEM.

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Graphic:

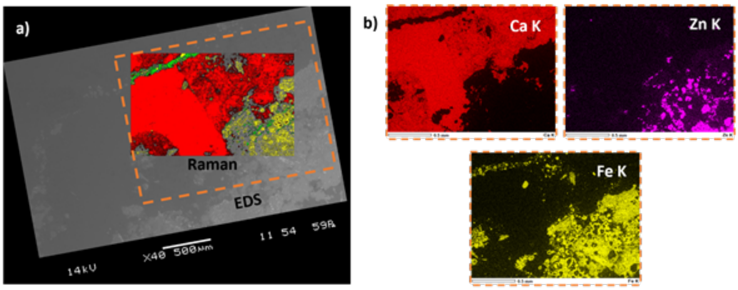

Figure 1. a) BSE image of a mineral section with overlayed Raman image illustrating the distribution of calcite (red), pyrite (yellow), and anatase (green); b) complementary EDS information agrees with the Raman data, and in addition highlights Zn due to the presence of sphalerite.

Keywords:

Raman imaging, Correlative analysis, SEM