High Lateral Resolution Microanalysis of Ceramic and Refractory Materials with the CAMECA SXFiveFE

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Abstract

The development of the Schottky emitter and its implementation as electron source in Electron Microprobe has significantly improved the characterization of materials in earth sciences, in metallurgy and in ceramic industry.

The strength of an Electron Probe Microanalysis (EPMA) is the ability to accurately measure and quantify element in traces at few 10's ppm level. The Field Emission (FE) Source allows major elements and trace elements analysis with high beam currents thanks to the high brightness of the source and the excellent stability of the beam current, trading off spatial resolution. Of course, accuracy of major element quantification is maintained with a FE source.

As X-rays are generated from a much larger diameter than the diameter of the incident electron beam, it is advised to work at low voltage and low beam current in order to take full advantage of the small spot sizes achievable with a Field Emission Source. Thus, at low beam voltage, the analytical resolution is not limited anymore by the beam diameter but only by the diameter of the X-ray emission volume.

One of the advantages of the FE Source is to obtain fine focused electron beam at low beam voltage (≤10 keV) while maintaining high and stable beam current. In these experimental conditions, the penetration depth of the primary electrons and thus the interaction volume- in which electrons are scattered and generate X-rays- decreases to sub-µm scale (compared to micron scale of the traditional Electron Microprobe at 15 or 20 keV).

Thanks to WDS spectrometers with sub 10eV energy resolution, accurate qualitative and quantitative analysis can be achieved even on sub-micron phases at low beam energy and high lateral resolution.

The SXFive FE analytical capabilities will be illustrated by analyzing a porcelain vase based material. High spectral resolution WDS spectrum will be used to determine the composition of the specimen. X ray maps acquired at low beam voltage will demonstrate the analytical resolution that can be achieved using the SXFiveFE.