Combined FIB-SIMS technique and its application

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Introduction

Recently, a new equipment which combined the focused ion beam scanning electron microscope (FIB-SEM) with a smart time of flight secondary ion mass spectrometer (TOF-SIMS) has been developed. The mass resolution of the TOF-SIMS is 800, the lateral and depth resolutions are 40 nm and 3 nm, respectively, and the detection limit is 3 ppm. This combined FIB-SIMS technique can analyze hydrogen to uranium (including isotopes). Both positive and negative ions can also be detected. It can make up the disadvantages of X-ray energy dispersive spectrometry (EDS) and wavelength dispersive spectrometry (WDS) which can not analyze low atomic mass elements, such as hydrogen and lithium, as well as isotopes, with poor detective sensitivity and spacial resolution.

Application

Two coexisting minerals in a granitic pegmatite sample can not be identified by EDS spectrum. The total amounts of these two minerals analyzed by electron probe microanalyzer (EPMA) equipped with WDS are not nearly to 100%. We have suspected if there are some low atomic mass elements which can not be detected by EDS or WDS. Therefore, the combined FIB-SIMS technique was applied to investigate the low atomic mass elements. According to the results of the combined FIB-SIMS technique, one of the unidentified mineral contains obvious amounts of hydrogen and lithium, and meanwhile another one hydrogen and boron. Consequently, the coexisting lepidolite and tourmaline have been identified successfully by combined FIB-SIMS technique, EDS and WDS analysis.

Furthmore, we have also analyze the distribution of trace uranium by the combined FIB-SIMS technique in cells after staining. Vertical distributions of 6 elements for multilayers have been investigated either.

Conclusion

Consequently, the combined FIB-SIMS technique can not only analyze low atomic mass elements and isotope, but also can be used on the researches of lithium battery, multilayers, biology, semiconductor and precipitated phase between crystal boundaries, etc. based on its high lateral and vertical spacial resolutions which are in the order of nanometers.