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doi:10.1017/S1431927617011813
Microsc. Microanal. 23 (Suppl 1), 2017

Identification of Fluorescent Material Using FE-SEM/EDS and a Variable Pressure Secondary Electron Detector

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A fluorescent material was suspected to cause an overestimate of the amount of tritium using liquid scintillation counting to detect tritium. Initially, these particles were difficult to identify amongst a large background of non-fluorescing particles. Using FE-SEM/EDS and a variable pressure secondary (VPSE) detector, fluorescing particles were found to contain strontium and aluminum, leading to the conclusion that culprit was strontium aluminate, a commercially available photoluminescent phosphor.

Swipes are used to determine tritium activity by gently rubbing over the surface to absorb tritium containing material in order to determine removable as opposed to fixed tritium contamination. These swipes are then measured by liquid scintillation counting, which uses fluorescent detection. Several swipes showed anomalously high readings that seemed to conflict with the radiological history of the items tested. It was suspected that there might be some fluorescent material that was picked up as part of the swipe that was giving anomalously high results. Materials that fluoresce under light excitation are often found to fluoresce under electron bombardment as well, since the electron bombardment is simply another method for excitation of the fluorescent material. Cathodoluminescence is light produced by the bombardment of materials by electrons and has been used to identify impurities in minerals [1].

The sample was first analyzed without the VPSE detector. The result was a categorization of materials that were not known to be fluorescent, yet which made up the majority of the particles on the swipe itself (see Figure 1). Recognizing that the VPSE detector on our instrument was a light sensitive detector, an attempt was made to identify fluorescing particles using the VPSE detector. When these were located, FE-SEM/EDS was used to obtain elemental information and identify these particles (see Figure 2), which were in fact different than the particles as identified in the first attempt. The particles located contained aluminum and strontium, leading to the conclusion that these were particles that contained strontium aluminate, a commercially available photoluminescent phosphor. Speculation is that these particles were from luminescent guides on the floor, intended to show exit paths in the event of a power failure [2].

References:

[1] JVP Long and SO Agrell, Mineralogical Magazine and Journal of the Mineralogical Society **34** (1965), p. 318.
[2] Savannah River National Laboratory is a Department of Energy National Laboratory operated by Savannah River Nuclear Solutions.

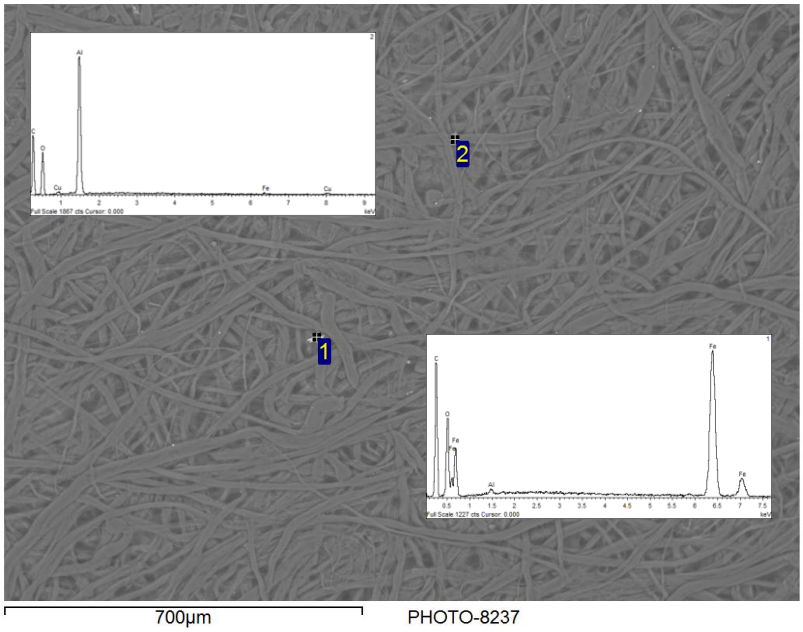

Figure 1. FE-SEM image with EDS spectra of two particles, whose composition is not known to be fluorescent.

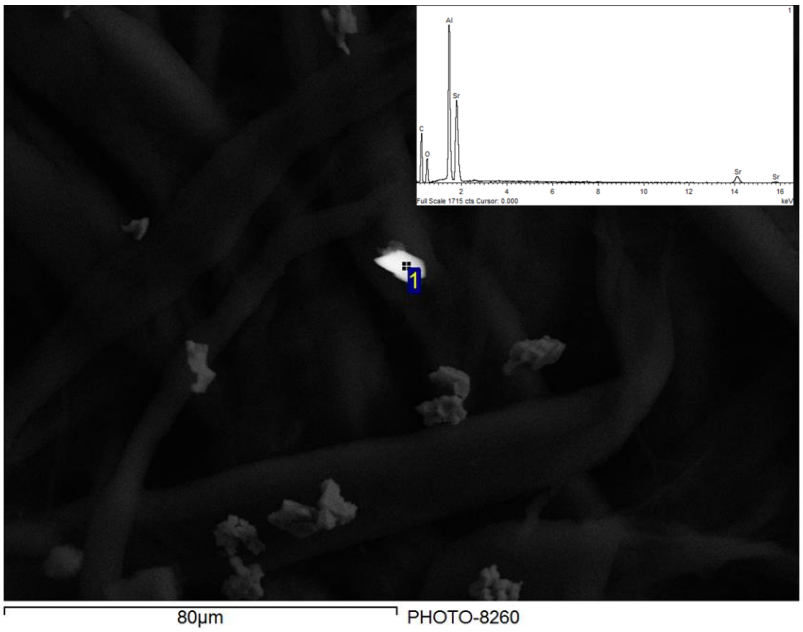

Figure 2. FE-SEM image with EDS spectra of a typical fluorescent particle, which contains strontium and aluminum and was surmised to be strontium aluminate.

https://doi.org/10.1017/S1431927617011813 Published online by Cambridge University Press