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Very Large Area EDS Spectral Images: Impact of Latest Silicon Drift Detector Technology

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From its first implementation Energy Dispersive x-ray Spectroscopy (EDS) has been characterized by its usefulness in characterizing elemental distributions in a sample, but also by its relatively low maximum count rate [1]. With the development of the Silicon Drift Detector (SDD) [2, 3], the limitation of maximum count rate has been greatly reduced.

Current EDS systems now have large area SDDs, improved digital pulse processors, and very fast computers, which allows collection at storage rates over 100kcps while maintaining acceptable resolution. Coupled with an SEM with automated sample stage, it is possible to step a sample through a grid pattern, collect a spectrum at each node of the grid and then post process all of these maps as one large Spectral Image [4]. These technology advances make the EDS analysis of large areas of a sample achievable in much less time by more analysts with SEM for doing phase mapping, finding minor phases or unexpected features [4]. The use of a dual detector system cuts analysis time in half again as it provides two independent channels for processing x-ray pulses.

Figure 1 shows maps for F, Ti and Sb overlaid on a BSE image of a brake pad. This view combines a set of 3 rows and 4 columns of maps and images. The total acquisition time was about one hour. The x-ray image resolution is 1.57 microns. The acquisition used a Thermo Scientific NSS system with 100mm^2 UltraDry detector mounted on a JEOL JSM-7001F FESEM.

Figure 2 shows maps for Fe and Pb next to a representative image of section of Ag paste applied to a silicon solar cell. The area covered is approximately 200 microns wide by 5 mm long and was acquired with 2 micron x-ray map resolution in about 30 minutes. This data was acquired with Thermo Scientific NSS system with a 30mm^2 UltraDry detector mounted on a Hitachi SU-6600 FESEM. This data is especially interesting as it shows the possibility of SEM/EDS as an alternative to a small spot EDXRF analyzer. Limited only by the size of the sample stage in the SEM used, it is possible to collect maps ordered in a line that provide more resolution and more information than is provided by a single point line profile acquired by EDXRF.

References:

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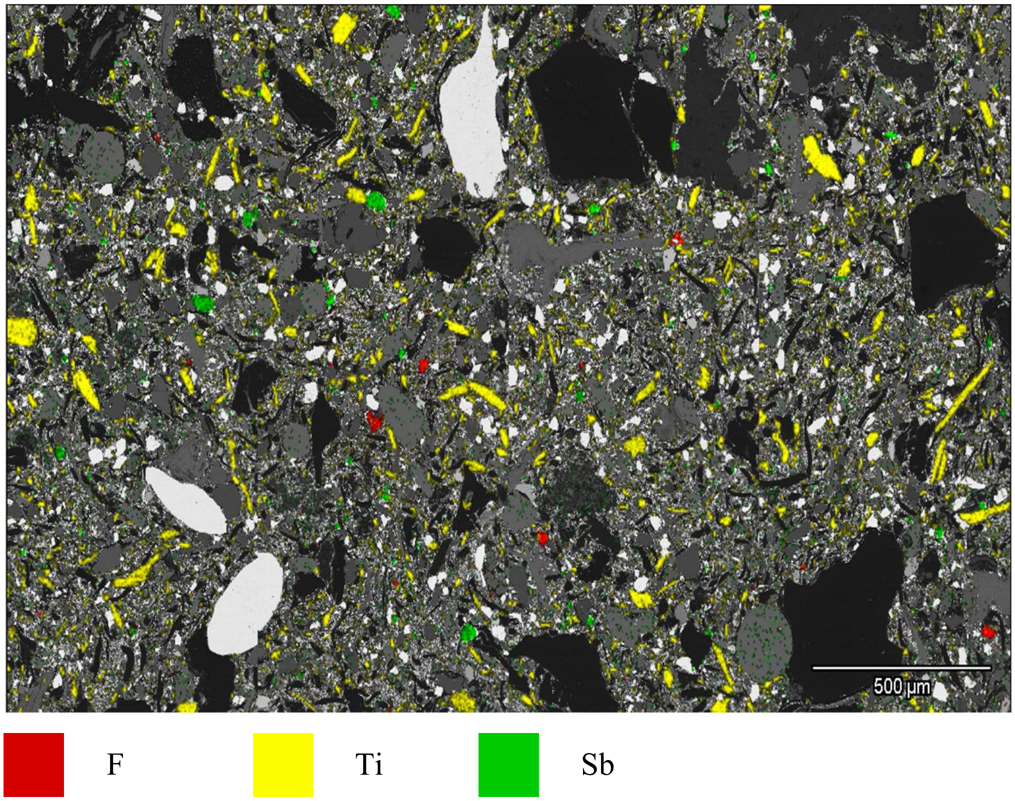

Figure 1. Maps for F, Ti and Sb overlaid on BSE image of a ceramic brake pad. 15kV. The area analyzed is about 2.9 by 1.6 mm.

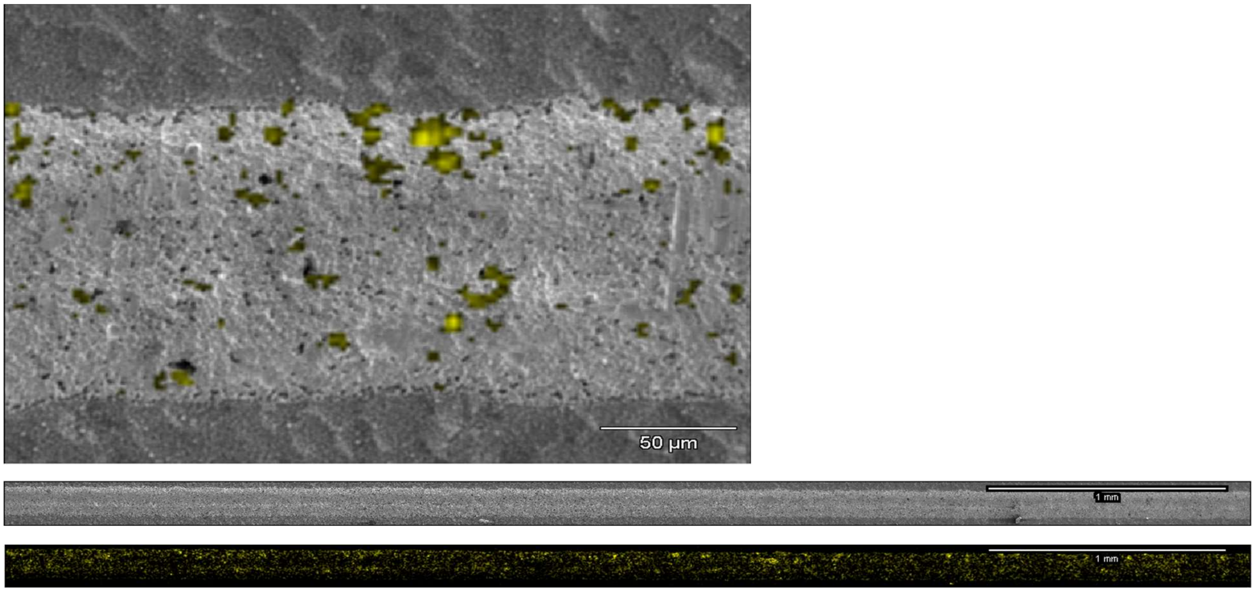

Figure 2. Ag paste contact line on a Silicon Solar Cell. This data set consists of a series of 19 x-ray maps covering a stripe 200 microns by 5 mm. The long strips are the electron image and the Pb net counts image. The large image shows one of the individual electron images with the Pb data overlaid. Data were acquired at 15 kV.