Energy Dispersive Spectroscopy (EDS) has been used for years to analyse the chemical composition of materials, including biological matter. New large area SDD detectors offer analysts the opportunity to gather up to 15 times the counts achieved on an older 10mm² detectors without changing any other collection conditions.

Now large area mapping (LAM) software allows analysts to map a whole sample in just one run. The analysis area is defined, the EDS map resolution and magnification set and then individual fields are mapped. When all the fields have been analysed, they are montaged into a single image which can be magnified to see details that are invisible in the larger map.

Here, we present results from a biological sample, analysed with a Oxford Instruments X-Max® 150mm² SDD detector at 4kV on a TESCAN Mira FEGSEM. Figure 1 shows a wheat seed which has been embedded in resin and stained with OsO4 to highlight the fatty acids surrounding the phospho-rich structures in the aleurone cells. The Os Mα and P Kα peaks overlap (Figure 2) but can be deconvoluted with ‘TruMap’ software to ensure accurate maps are obtained. Figure 3 shows the results achieved with a 10mm² EDS detector (Fig. 3a) compared to those taken on an X-Max® 150mm² EDS detector (Figs. 3b & 3c).

The X-Max® data is clearly superior in both counts & image definition. The oily bodies are clearly delineated in the Os map and easily identified as separate structures from the P-rich areas. Counting for longer yields improved signal to noise and offers sufficient structure in the Os map to enable individual oily bodies to be identified (Fig. 3c). Combining the maps into a single layered image (Fig. 3d) clearly illustrates the elemental distributions found across the sample.

Figure 4 shows a 122 individual EDS maps (each 250μm by 250μm) montaged together to make a large area map showing the chemical variation across the whole sample - a total area of 3mm by 3.5mm. The LAM can be interrogated after collection and individual maps magnified to illustrate points of interest as required.

Conclusions:
New large area SDD EDS detectors offers biological analysts a new way of collecting important information about their samples. Improved collection efficiencies mean higher count rates without changing the SEM operating conditions and large area EDS mapping allows data collection across a wide field of view. All while retaining the detail of individual maps. Finally, truly informative EDS data across a range of scales can be collected on biological or beam sensitive materials without compromising the sample.

References:

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Fig. 1: SEM image showing the internal structure of a wheat aleurone cell.

Fig. 2: EDS sum spectrum of a wheat seed showing the overlap between Os Mα & P Kα.

Fig. 3: Comparison of P Kα and Os Mα wheat seed EDS maps taken on a 10mm² EDS detector and 150mm² X-Max® SDD detector.

Fig. 4: LAM montage of 122 individual EDS maps illustrating the chemical composition of the whole wheat seed from micron scale to millimeterscale. Montaged maps include: BSE Image, C Kα, Ca Lα, Os Mα. Bottom right image shows a highly magnified section of the Os Mα map.