Low-kV STEM Imaging of Soft Tissues for Pathology

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Abstract

Transmission electron microscopy (TEM) imaging of ultrathin sections cut from fixed and embedded blocks has for many decades been the modality of choice for fine structural analysis of tissue, changes of the cell interior, organelles and the extracellular matrix. This technique plays a key role in the pathological diagnosis of renal, skin, complex and rare diseases. Almost any sample from a renal biopsy will be processed and imaged using electron microscopy carried out at 80-120 kV, with many microscopists choosing 80 kV for a balance between increased contrast and sufficient resolution. However, the increasing cost and complexity of deploying EM and the associated infrastructure required for them restricts its availability and usage to only a handful of metropolitan locations. This can add time to critical disease diagnosis for patients and clinicians in rural and remote NSW and Indigenous communities.

Scanning transmission electron microscopy (STEM) systems have been available as an additional modality for TEM systems, promising increased contrast, particularly from unstained sections. While STEM systems have been available on TEM instruments for some time, perhaps due to their complexity, it has not been commonly used for ultrastructural examination in cell biology and pathology.

We will present the advantages of low-kV STEM imaging using the highly automated Phenom Pharos G2 FEG-SEM with the recent addition of the new scanning transmission electron microscopy (STEM) detector. The STEM detector can achieve a higher resolution than the BSD detector [1], especially at voltages up to 20 kV. This instrument not only presents a desktop space-saving form but also boasts sophisticated stage automation and image acquisition algorithms. The STEM detector attached to the Phenom desktop microscope allows the wide area imaging of key cellular changes in renal disease and other diseases.

References

1. Cohen Hyams T; Mam K; Killingsworth MC, 2020, 'Scanning electron microscopy as a new tool for diagnostic pathology and cell biology', Micron, vol. 130, pp. 102797 - 102797, http://dx.doi.org/10.1016/j.micron.2019.102797.