Choose the Right SEM — Analysis Edition

The holy grail of nanoscale analysis with EDS is to quickly analyze any features which can be imaged in the SEM. However, for nanoscale features this is complicated by that fact that X-ray spatial resolution is typically larger than SEM imaging resolution. Figure 1 shows EDS maps from an integrated circuit cross section at 15kV and 6kV using a W SEM and an FE SEM, as well as the approximate X-ray signal depths at those voltages.

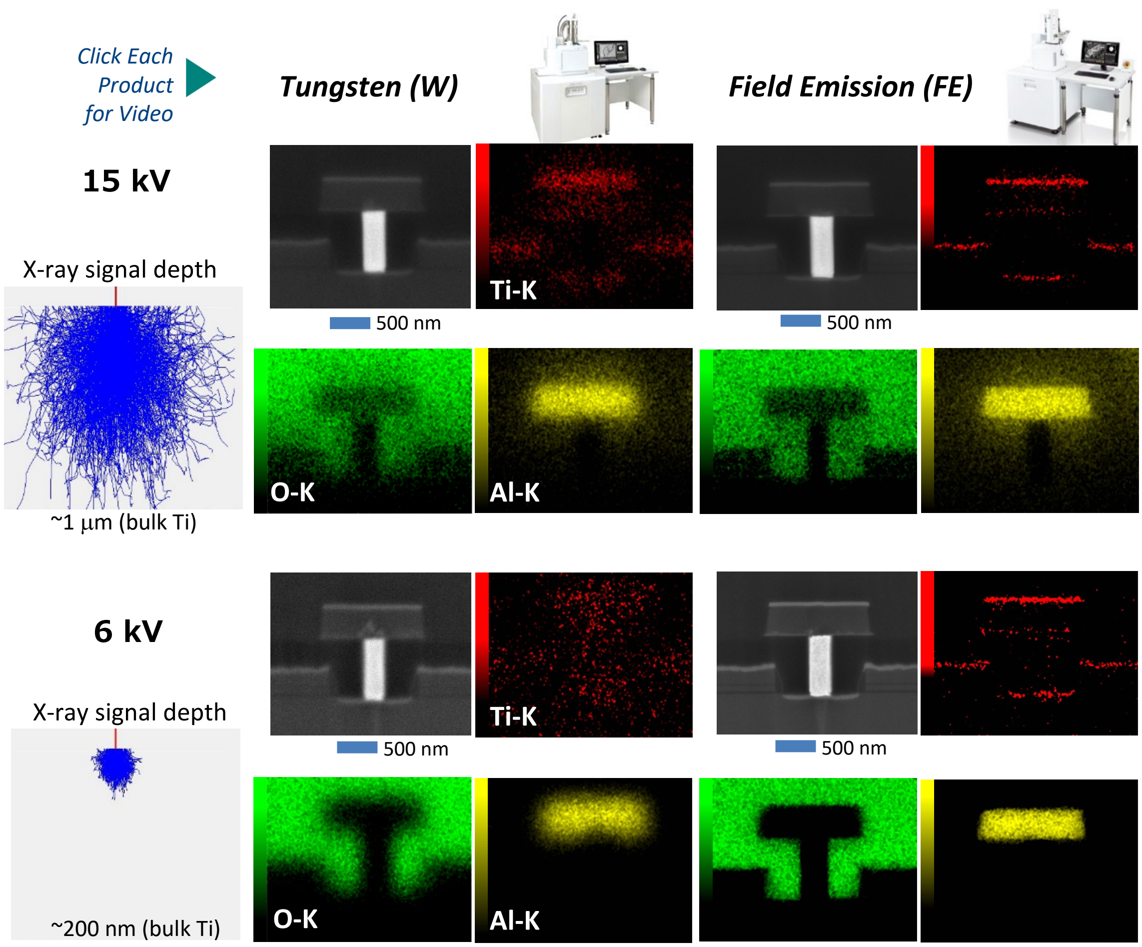

Figure 1: EDS maps (same count rate/total time) from IC cross section at 15kV and 6kV using a W SEM and an FE SEM.

The W SEM is suitable for analysis of larger structures (hundreds of nm). Lowering kV allows for a smaller X-ray signal depth within the sample and thus higher X-ray spatial resolution (see the O and Al maps). If ultra-high X-ray spatial resolution is needed to resolve ~50nm layers (see the Ti maps), then an FE SEM is the best option, since FE emitters maintain a very small spot size even at low kV. Table 1 shows a comparison of some relevant parameters between thermionic tungsten emitters and Schottky field emission emitters.

Parameters	Thermionic Tungsten	Schottky Field Emission
Brightness (A cm^{-2}sr^{-1})	10^5	10^7-10^8
Energy spread (eV)	1-3	0.5-0.6
Life time	~100 h	~3 years or longer

Table 1: A comparison of parameters between thermionic tungsten and Schottky field emission emitters.

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