Scanning electron microscopy

Dr David McCarthy, Electron Microscopist at the School of Pharmacy, UCL, explains how to create three-dimensional images using high-resolution episcopic microscopy.

DM: The lowest magnification I can get on this is probably about 30, 40 times and the highest mag – I can go up to 3 million on this one. Yes, it's some range. [Laughs]

A scanning electron microscope is a microscope which uses electrons for probing on the surface of a sample.

Right, the samples normally come in vials or little polythene bags – powders or whatever – and we pick up one of these stubs, aluminium stub, SEM stub, and the sample sits on the surface. We have to use something to stick it down and we use these little carbon impregnated discs, which we stick on and then we can just dust on the sample and then we use a can of dust-off to blow off any excess sample, and then we'd pop it in the sputter coater and coat with gold for a couple of minutes.

People use gold because it's probably the cheapest form of metal coating. What you want is a replica of that surface, so that when your primary beam electrons hit that surface, lots of electrons are generated. This is a top-of-the-range field emission scanning electron microscope. Electrons do not travel in air, they only travel in high vacuum. The electrons are formed into a fine beam of electrons by a series of electromagnetic coils, which arrest that over the surface of the sample. The electrons hit the sample, collide with electrons on the surface of the sample, giving off reflected electrons or secondary electrons. These secondary electrons are attracted towards the secondary detector here and then the electrons hit the window, which is just the other side of the cage, and knocks out a photon of phosphor, and what we actually convert electronically is a photon image.

We're going to go into go into high-vacuum mode and pump, and you'll hear the pumps come on. So I'm going to switch on the beam. So now it's in focus but it's very noisy, so now I'm going to slow the beam down. So if I just press that one there, you can see just how much that improves by slowing the beam down. Good-quality images can be low-magnification, high-magnification, it's a bit like a photograph. I think a good image must have a combination of being good to look at and scientifically informative. I'm very pleased with that image.

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