

Isolating Vibration on Light Microscopes?

The following are answers to the above question as recently provided on the Microscopy Listserv:

- A slab of cement, marble, etc. about 24 inches square and 2 inches thick for mass. The heavier the better. Your local paving store will oblige. Four tennis balls under the slab for air springs. OR the inner tube of a tire with the valve relocated to the outside for easy re-inflation is a more compliant isolation spring.

--- Mel Dickson

- The Zeiss confocal as some sort of airbag/tyre system for vibration isolation, like the suggested tractor inner tubes. We have used a bicycle inner tube about 3/4 filled with water under a heavy terrazzo (fake marble) slab - seems to work OK.

--- Rosemary White, Monash University, Australia

- Tennis balls under a wooden frame, on which the LM sits. We had 6 under a large Zeiss Universal for years and we are right next to a busy road on the 2nd floor. Works like a dream!

--- Diana van Driel, Sydney University, Australia

- Try A.Q. Sorbothane feet - A set of four hockey puk style "rubber" feet that should cut vibration on most scopes. If not, try a Kinetica air table at \$3,500.00. Sorbotane or other vibration absorbing products can be found in any audiophile magazine - a big mail order company that would have it is Audio Advisor at (800)942-0220. Four Sorbothane big feet should run ~ \$50.00 and for heavier scopes there are Sims Navacom silencers for about \$75.00. Or try the Needle Doctor at (800)229-0644.

--- Scott E. Berman, Advanced Imaging Concepts

Field Emission Basics: The Water Bucket Analogy

Doug Rathkey, FEI Company, Hillsboro, OR

This article uses an interesting analogy to define and compare the three basic mechanisms of electron emission: photoemission, thermionic emission, and field emission.

The Fermi Level and Three Emission Mechanisms

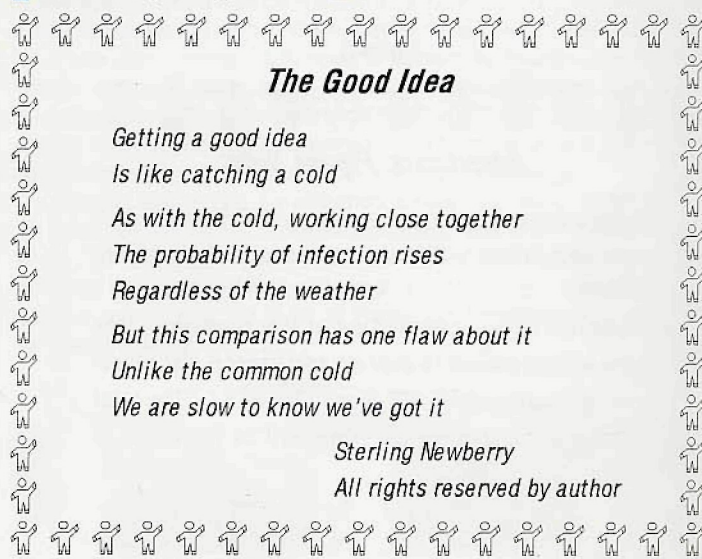
In the water bucket analogy (Figure 1), the water level in a bucket represents the Fermi level - the highest occupied energy level in the cathode material. The work function is the energy required to get the "water droplets" (electrons) from the top of the liquid out of the bucket and over the side (i.e., the distance equivalent to the potential energy barrier).

In photoemission, the energy of a photon can remove an electron at the Fermi level from the cathode material and can impart enough kinetic energy of travel to allow it to escape from the bucket (Figure 1a). In thermionic emission, heat provides the energy to boil the electrons off and out of the bucket (Figure 1b). Finally, in field emission, a high electric field can thin the side of the bucket enough so that the electrons can tunnel right through it (Figure 1c). There are two types of field emission: cold field emission (CFE) and Schottky emission (SE).

Figure 2 presents the corresponding energy level diagram for thermionic emission (Figure 1b). Theoretically, thermionic emission has no electric field, and therefore, has an infinitely thick potential energy barrier (in our analogy, this means that the wall of the water bucket would be infinitely thick). In practice, an electric field must be applied to allow the electrons to escape from the surface of the cathode material.

Figure 3 presents the energy level diagrams for CFE and SE. Both have similar energy spreads, but their energy distributions are mirror images. In CFE, electrons tunnel from various energies below the Fermi level, while with SE, thermally excited electrons escape over a field-lowered potential energy barrier. In commercial focusing columns, submicron electron beams are produced using two of the three emission mechanisms: thermionic emission (tungsten and LaB₆ emitters) and both CFE (pointed tungsten emitters) and SE (SE cathodes).

The CFE and SE sources provide a higher brightness electron source than conventional thermionic sources. Brightness is defined as the on-axis current-per-unit solid angle, divided by the virtual area of the emitting source. This means an increase in current density for nanometer focused beam sizes - particularly for low beam voltage applications where source brightness is a key factor. CFE and SE sources are being used for applications such as electron beam lithography, low voltage SEMs, and some surface analysis equipment, for which small focus beam size and high current density are key requirements. Thermionic sources, such as LaB₆ and tungsten filaments, continue to be used in focusing columns that support traditional SEM and surface analytical applications. ■



The Good Idea

Getting a good idea
Is like catching a cold
As with the cold, working close together
The probability of infection rises
Regardless of the weather
But this comparison has one flaw about it
Unlike the common cold
We are slow to know we've got it

Sterling Newberry

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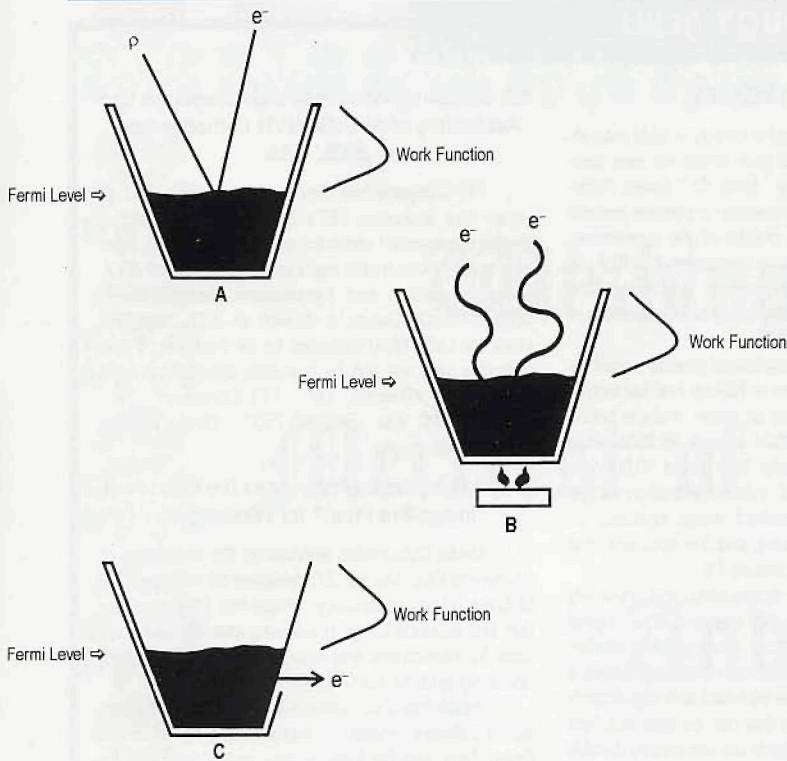


Figure 1: Using the water bucket analogy the water is at the Fermi level, and the wall of the bucket represents the work function that must be overcome to get water droplets (electrons) out of the liquid and up and over the side.

Figure 1a: In photoemission, the electrons are excited over the potential energy barrier (the distance of the work function) by the incoming photons.

Figure 1b: In thermionic emission, the electrons are thermally excited over the potential energy barrier (boiled off).

Figure 1c: In field emission, the electrons tunnel through the potential energy barrier which has been thinned by application of a high electric field.

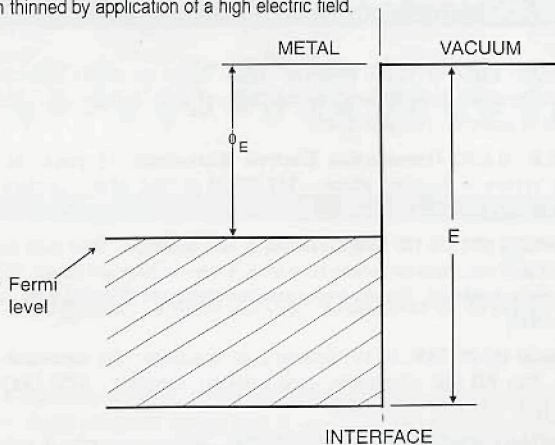


Figure 2: This energy level diagram for thermionic emission corresponds to Figure 1b in the water bucket analogy. ϕ_E is the work function.

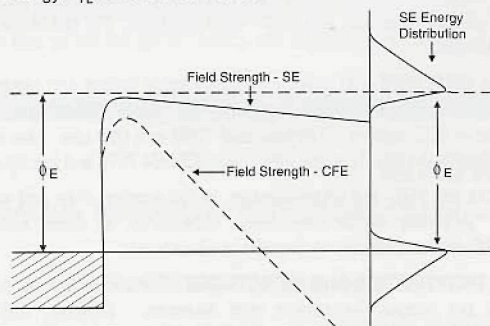


Figure 3: This drawing presents the potential energy diagram for Schottky emission (SE) and cold field emission (CFE). The energy distributions found in cold field emission and Schottky emission are equally narrow and are mirror images of one another.

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