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Using Fowler-Nordheim plots to measure characteristic local field values

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An *ideal* field electron emission (FE) device/system is one in which: (a) the measured current I_m equals the emission current I_e; (b) the characteristic local barrier field F_C is related to the measured voltage V_m by the formula F_C = V_m/ζ_C where the *voltage conversion length* ζ_C is effectively constant; and (c) the work-function is constant. An orthodox FE device/system is an ideal system where it is adequate to assume, further, that FE can be treated as tunnelling through a Schottky-Nordheim ("planar image rounded") barrier, well below the top of the barrier, that the work-function value is adequately known, and that the pre-exponential correction factor λ in the so-called extended Murphy-Good FE equation can be treated as constant. The purpose of this Poster is: (a) to remind people that it has been known since the 1950s that, for orthodox FE devices/systems, a Fowler-Nordheim plot can be used to measure the characteristic local barrier field, subject to a systematic "calibration discrepancy" of around 30%; and (b) to put this measurement procedure into a useful modern form involving the characteristic scaled field f_C . The mathematical basis of the procedure (which is now based on the extended Murphy-Good FE equation) will be described, the issue of precisely what is being measured will be discussed, and a reminder will be given of the 1950s experiments undertaken in order to check/calibrate the procedure. As illustration, the procedure will be applied to several carbon-based emitters that exhibit low-macroscopic-field (LMF) emission, in order to demonstrate that actual local barrier field values are in the normal range of a few V/nm and are not anomalously low (as hitherto assumed by some authors). Rather, characteristic field enhancement factors must be anomalously high.

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