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Theoretical investigation of real supply current distributions for metallic field emission

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Electron field emission and the related process of strong laser-field emission are promising mechanisms for the creation of high brightness beams. These processes deviate from the photoelectric effect in that the normal energy –not the total energy –is the predominant factor determining the likelihood for an electron to ionize. In this paper we continue our investigation of the material normal energy distribution (MNED), which is the supply current as a function of the normal energy. We derive analytical expressions for the MNED and mean transverse energy (MTE) for two cases: that of a smooth Fermi surface, and that of a Bragg plane intersecting Fermi surface in a weakly binding potential. We compare these analytical expressions to results calculated using density-functional theory (DFT) for tungsten and copper surfaces. We find explainable discrepancies between our analytical results and the DFT results for the W(100) direction and the Cu(111) direction, associated with the Fermi surface intersecting a Bragg plane, but otherwise find general agreement.

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Footnotes

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