ELEM
Code for evaluation of the field to thermo-field to thermionic electron emission current

The code evaluates the Murphy-Good formalism and realizes the numerical method [1], which employs Padé approximants. The code provides a calculation accuracy of 10^{-3} in the entire range of conditions for the validity of the Murphy-Good theory, from field to thermo-field to thermionic emission regimes.

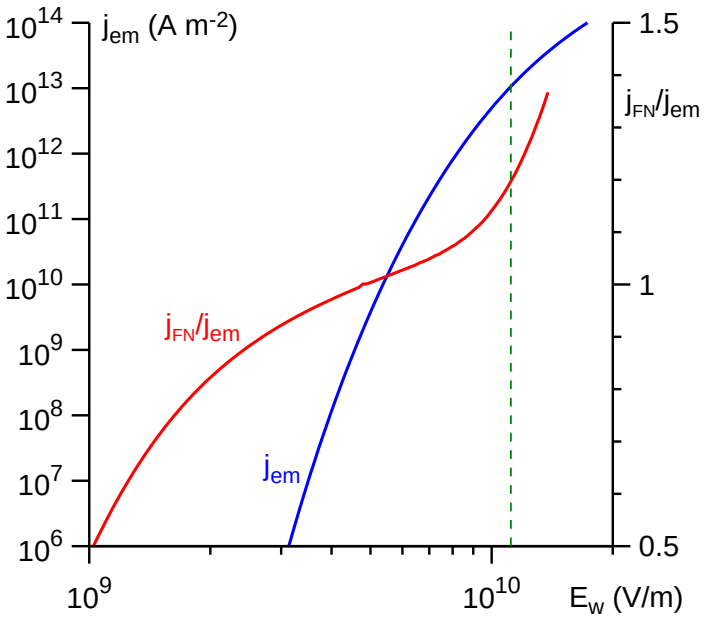
Properties of the emitting material are characterized in the framework of the standard Murphy-Good theory by just one parameter, the work function. In the code, this parameter is specified by the user through the file input_emission_TF.dat. On the other hand, two parameters appear in the Richardson-Schottky formula: in addition to the work function, the factor in front of the exponent is represented as $A_{em} = \lambda_R A_0$, where λ_R is a material-specific correction factor that is typically of order 0.5 and A_0 is a universal constant given by $A_0 = 4\,\pi\, m_e\, k^2 e\,/h^3 \approx 1.2017 \times 10^6$ A/(m K)^2. In principle, one could introduce the correction factor λ_R also into the Murphy-Good theory, which would amount to multiplying the emission current density, given by the standard Murphy-Good theory, by λ_R. However, this is not implemented in the code: the code is restricted to the standard Murphy-Good theory, so the user will have to him/herself multiply the emission current density given by the code by the desired value of λ_R if needed.

The input parameters (set of values of the electric field at the surface and of the surface temperature, the work function) are specified by editing the file input_emission_TF.dat (any ASCII editor can be used). The file is self-explaining.

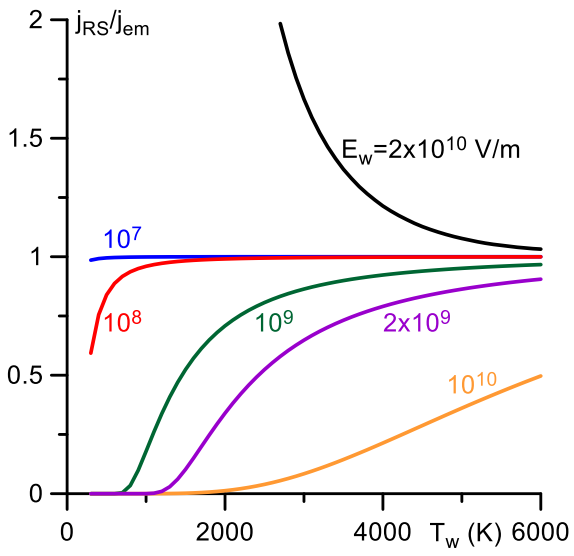
After you are done with the editing, click the file emission_TF.exe, which is an executable for Windows 64 bit. The runtime of the code normally does not exceed a second or two. The code will generate the output file emission_TF.dat, containing computed values of the electron emission current density and some other relevant data if requested. (An example of the output file is included in this distribution.)

The file reference_information.pdf may be used for references if needed.

Examples of calculation results:



j_{em}: electron emission current density computed by the code, T_w=300 K. j_{FN}: value given by the Fowler-Nordheim formula. Vertical line: limit of the region of applicability of the Fowler-Nordheim theory according to Murphy and Good 1956.



j_{em}: electron emission current density computed by the code. j_{RS}: value given by the Richardson-Schottky formula.

[1] M. S. Benilov and L. G. Benilova, J. Appl. Phys. **114**, No. 6, pp. 063307-1-7 (2013)

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