System for interpolating work function for cold field emission models

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Determining electron emission current density, J, from a metal requires knowing its temperature, T, field, F, and work function, ϕ. Experimentally, work functions have been determined for low-index planes of tungsten. But, models of hemispherical electron emitters may have surfaces in-between these known crystal plane directions. Therefore, addressing emission from neighboring vicinal planes requires interpolation.

Here, we demonstrate the interpolation of work function, ϕ^* over a spherical surface by following a methodology used by Hubbard[1] and later Radjenovic[2] to interpolate etch rates of materials from known crystal planes. The set of known work function planes is used to define a fraction of the sphere into which any arbitrary vector can be mapped by symmetry operations. By defining (curved) triangular regions in this fraction whose corners are known work function indices, a basis can be defined for each region. Any plane falling inside a region can have its work function interpolated by the basis weighted by known ϕ. This technique allows for smooth interpolation over the sphere given three or more experimental points.

[1]Hubbard, T.J. MEMS Design - Geometry of silicon micro-machining, PhD. Dissertation, California Institute of Technology, 1994)

[2]Radjenovic *et al.* (Sensors **2010**, *10*, 4950-4967 Level set approach to anisotropic wet etching of silicon

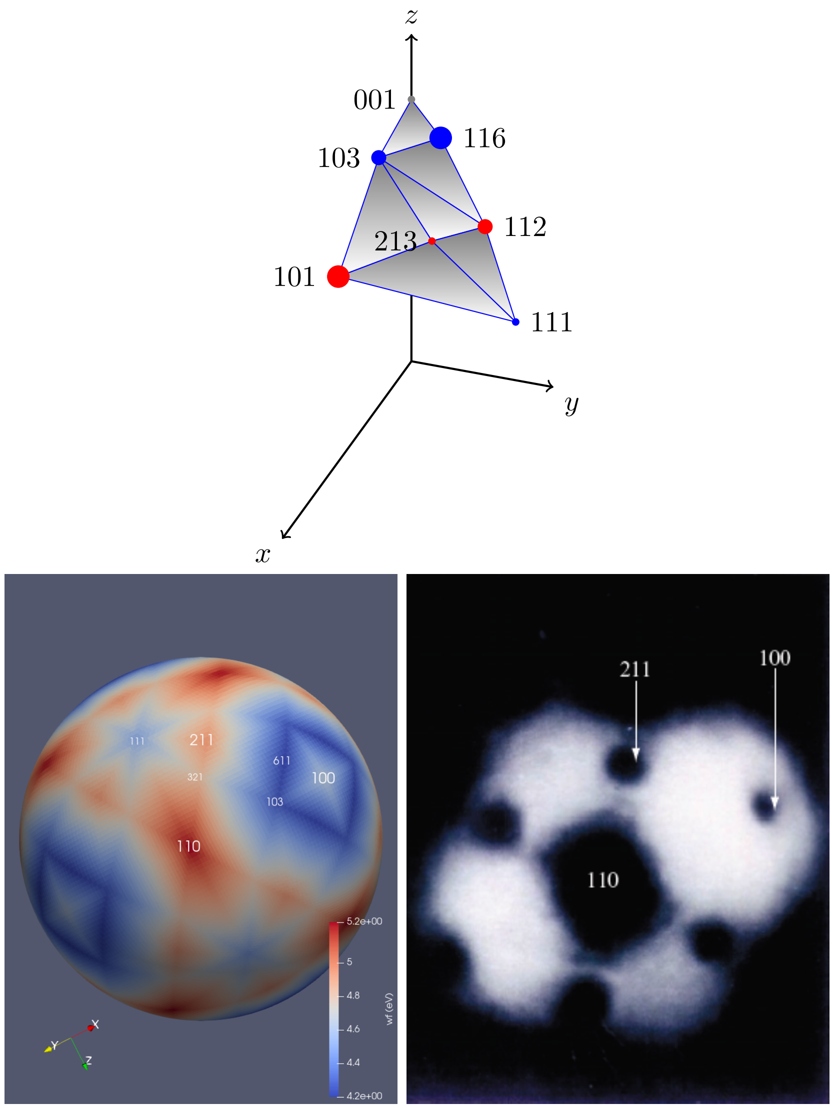

Figure 1: **Top** The regions are shown with sized colored dots on the experimental work functions. Large red is highest work function, small red is second highest, gray is median, small blue mid low, and large blue lowest work function. **Left** Fully interpolated spherical work function model, rotated to compare with **Right** Experimental emission pattern of a clean W<110> oriented emitter with major crystal planes noted (adapted from Swanson and Schwind, 2009). Here the brightness of the pattern varies inversely with the WF.