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Inelastic electron scattering in photoemission

The emission of photo-excited electrons through inelastic scattering mechanisms is demonstrated to be prevalent in both semiconductor and metal photocathodes. This type of Franck-Condon process requires an intermediate 'particle'to simultaneously satisfy momentum and energy resonant electron emission into the vacuum states; optical phonons in polar semiconductors and the reciprocal lattice vector in metals. An analytical theory of (optical)phonon-mediated Franck-Condon photo-excited electron emission is shown to be very consistent with the measured emission properties (both QE and MTE) of (i) a Cesiated GaAs(001) photocathode at 808nm [J. Phys. D: Appl. Phys. 54, 205301 (2021)] and (ii) a GaN(0001) photocathode from just below its band gap energy to 5eV. Preliminary results will also be presented to illustrate that incorporating Umklapp electron scattering effects into our band-based photoemission theory [New J. Phys. 21, 033040 (2019)] provides for an improved understanding of near and below threshold electron emission from metal photocathodes.

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