On the photoelectric quantum yield of small dust particles

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Photoelectron emission is crucial to electric charging of dust particles around main-sequence stars and gas heating in various dusty environments. An estimate of the photoelectric processes contains an ill-defined parameter called the photoelectric quantum yield, which is the total number of electrons ejected from a dust particle per absorbed photon. Here we revisit the so-called small particle effect of photoelectron emission and provide an analytical model to estimate photoelectric quantum yields of small dust particles in sizes down to nanometers. We show that the small particle effect elevates the photoelectric quantum yields of nanoparticles up to by a factor of 10^3 for carbon, water ice, and organics, and a factor of 10^2 for silicate, silicon carbide, and iron. We conclude the surface curvature of the particles is a quantity of great importance to the small particle effect, unless the particles are submicrometers in radius or larger.