Field enhancement at metallic interfaces due to quantum confinement

We point out an apparently overlooked consequence of the boundary conditions obeyed by the electric displacement vector at air-metal interfaces: the continuity of the normal component combined with the quantum mechanical penetration of the electron gas in the air implies the existence of a surface on which the dielectric function vanishes. This, in turn, leads to an enhancement of the normal component of the total electric field. We study this effect for a planar metal surface, with the inhomogeneous electron density accounted for by a Jellium model. We also illustrate the effect for equilateral triangular nanoislands via numerical solutions of the appropriate Maxwell equations, and show that the field enhancement is several orders of magnitude larger than what the conventional theory predicts. (C) 2011 Society of Photo-Optical Instrumentation Engineers (SPIE). [DOI: 10.1117/1.3574159]
