Electrostatic Mechanism of Strong Light Emission Enhancement in Metal-Semiconductor Nanostructures

Arkadii Krokhin (University of North Texas, US)

It is well understood that the efficiency of semiconductor light emitters can be modified by metals. This occurs through electrodynamic interaction, described by the coupling of carriers to surface plasmons. However, this picture does not include contributions from electrostatics. We propose here an electrostatic mechanism for carrier-metallic nanoparticle interaction comparable in effect to plasmonic interactions. Arising from Coulomb attraction of e-h pairs to their electrostatic images in metallic nanoparticles, this mechanism produces large carrier concentrations near the nanoparticle. In our experiments, this manifests as nonresonant emission enhancement in InGaN, GaAs, and ZnO quantum emitters radiating in the near-UV, visible, and IR regions. This fundamental mechanism provides a new perspective for improving the efficiency of broad-band light emitters.