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Plasmonic Electricity: Fluorophore-Induced Plasmonic Current

Abstract:

Fluorophore-induced plasmonic current is generated when an excited fluorophore in close proximity to a metal nanoparticle film non-radiatively transfers energy to the metal, resulting in an induced electrical current across the film. Although a growing literature reports the use of surface plasmons for fluorescence enhancement (Metal-Enhanced Fluorescence) as well as plasmons for current generation, little has been reported *hitherto* regarding the electrical current generation via the fluorophore excitation of plasmons. Our *"plasmon to current"* technique utilizes electron transport between closely spaced metal nanoparticles, generating a measureable electrical signal upon excitation of a proximal fluorophore. This induced electrical signal is found to be strongly dependent on the magnitude of the fluorophore extinction coefficient. In other words the electrical signal contains photophysical information pertaining to the fluorophore, potentially leading to the direct detection of fluorescence without the need for traditional detectors such as photomultiplier tubes and charge coupled devices. Such a realization would have profound implications in optical detection strategies. In addition, we demonstrate the dependence of this current on fluorophore concentration, excitation laser polarization, background solution dielectric, temperature and choice of metal etc. Finally, we will demonstrate the inverse relationship between plasmonic current and metal-enhanced fluorescence generation.

Fluorophore-induced plasmonic current holds significant potential as a novel molecular detection platform with simplified instrumentation, compatible with a variety of fluorescent probes.