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Electrically driven plasmon nanosource, application to a plasmonic lens

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To optimize the optoelectronic properties of plasmon based nanostructures and their integration in functionalized nanodevices, it is crucial to design dedicated electrical nanosources of surface plasmons, whose size is compatible with that of the studied nanostructures. Here, we report an electrical surface plasmon nanosource using inelastic electron tunneling from the tip of a Scanning Tunneling Microscope (STM). The main advantages of STM induced surface plasmon excitation are: (1) the very local excitation (10 nm) which enables precise localization of the excitation inside the nanometer size plasmonic devices, (2) the nature of the excitation which is equivalent to a point-like vertical dipole, (3) the low energy electrical character (≈ 3 eV) of the excitation which makes nano plasmonics compatible with nanoelectronics and (4) the ability to excite both localized and propagating surface plasmons with a broadband energy distribution. As an example of the integration of this electrically driven plasmon nanosource into elementary plasmonic devices we show the production of cylindrical vector beams of light from an electrically excited plasmonic lens. The plasmonic lens consists of concentric circular sub wavelength slits that are etched in a thick gold film. Due to the very local electrical excitation of the plasmonic lens, a highly collimated beam with an angular divergence of less than 4° and a polarization with a cylindrical symmetry are demonstrated. The variable direction of emission is controlled by the precise positioning of the STM tip.

Biography

Gerald Dujardin has started working at IBM, USA. His current research interests are focused on the electrical excitation of hybrid plasmon-exciton optical nanodevices.

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