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Visible and Infra-red Resonant Light Scattering from Plasmonic Nanowire
Architecture

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Visible and Infra-red Resonant Light Scattering from Plasmonic Nanowire Architecture

Background

The objective of this proposal is to study angle-dependent scattering from individual plasmonic nanowire architectures placed on a dielectric substrate. We will utilize Fourier-plane optical microscopy method to resolve the angular scattering as a function of spherical co-ordinates: azimuthal and polar angles. Our measurements will be corroborated by numerical simulations based on finite difference time domain and finite element analysis. Using the proposed method we will be able to measure broadband (visible and infra-red) scattering from a single plasmonic nanowire spanning polar angles from -70 degrees to +70 degrees, and azimuthal angles from 0 to 360 degrees.

Progress:

We have been focusing on the technique to prepare nanowire-nanoparticle junction (Nw-Np). The Nw-Np junction between the nanowire and the nanoparticle can act as a hotspot for the huge electric field and can probe the molecular emission from the molecules at the junction. We have found that the technique is not limited to only metallic particles but can be used to prepare metallo-dielectric junctions as well. These hybrid metallo-dielectric junctions have less ohmic losses compared to metallic-metallic junction and are great candidate for studying the high quality factor whispering gallery modes (WGMs) of the dielectric microsphere. One such type of metallo-dielectric junction is dielectric bead coupled to a metallic nanowire (Nw- μ S).

Remote excitation of the WGMs of the Microsphere-

Scheme of the Experiments- For the excitation of the WGMs of the microsphere coupled to the nanowire, we excite one end of the nanowire. Exciting one end of the nanowire launches propagating surface plasmon polaritons (SPPs) in the nanowire travelling along the length of the nanowire which outcouple at the scattering points along the wire and at the distal end. At the junction, where the dye coated microsphere is resting on the nanowire, these propagating SPPs excites the molecules coated on the microsphere and the near field of the molecular emission gets couple to the WGMs of the microsphere. The remotely excited WGMs along with the fluorescence of the molecules at the junction is collected by spatially filtering the junction and the spectral features and the directionality of the wavevectors were studied.

Future Direction

In this presented work, we are remotely exciting the WGMs of the microsphere. In the future we would like to channel the WGMs of the microsphere in the nanowire as the guided modes of the nanowire for the remote collection as well. We anticipate that since the collection would be through one end of the nanowire, the remotely collected signal would be highly directional in nature. Thus the remote excitation and collection of the directional WGMs can be possible. Also, we would like to extrapolate the measurement towards infra-red wavelengths.

Journal Publications:

1. "Dielectric microsphere coupled to a plasmonic nanowire: A self-assembled hybrid optical antenna" Sunny Tiwari, Chetna Taneja, Vandana Sharma, Diptabrata Paul, G.V. Pavan Kumar,

Advanced Optical Materials, 1901672 (2020)

2. "Large-scale optothermal assembly of colloids mediated by a gold microplate" Sharma,

Vandana; Paul, Diptabrata; Pavan Kumar, G.V., **J. Phys. Cond Mat.**, 32, 324002 (2020)

3. V-shaped active plasmonic meta-polymers

Debrina Jana, Adarsh Vasista; Harshvardhan Jog, Ravi Tripathi, Monica Allen, Jeffery Allen, G.V. Pavan Kumar

Nanoscale, 11, 3799-3803 (2019)