Supplementary Materials: Fluorescence Enhancement Using Bimetal Surface Plasmon-Coupled Emission from 5-Carboxyfluorescein (FAM)

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Figure S1. (a) and (b) represent reflectance curves as a function of incident angle, for a single layer of Au and Ag of various thicknesses, respectively. (c) and (d) represent enhancement of the electric field intensity versus distance from the metallic surface in a liquid region at the excitation wavelength ($\lambda_{ex} = 470$ nm).

Calculation of Electric Field Intensity Enhancement

We computed the reflectance of light in a Kretschmann-Raether surface plasmon resonance (SPR) configuration, using an optical transfer matrix formula, for a multilayer stack. For a multilayer stack of $N$ layers, labeled as 0 (prism) to $N$ (liquid with fluorophores), we assumed the transverse magnetic polarization of incident light and thus obtained the tangential components of the electric ($E_a$) and the magnetic ($B_a$) fields at the boundary between the layers $N-1$ and $N$, as follows:
\[
\begin{bmatrix}
E_a \\
B_a
\end{bmatrix}
= \prod_{i=1}^{N} \begin{bmatrix}
\cos \delta_i & -i \sin \delta_i \\
i \gamma_i \sin \delta_i & \cos \delta_i
\end{bmatrix}
\begin{bmatrix}
E_N \\
B_N
\end{bmatrix}
\]  

(1)

Here,

\[
\delta_i = \left(\frac{2\pi}{\lambda}\right)n_i d_i \cos \theta_i
\]  

(2)

\[
\gamma_i = \frac{n_i \varepsilon_0 \mu_0}{\cos \theta_i}
\]  

(3)

Here \( \delta \) is the optical phase introduced by a single traversal of the field across the \( i \)th layer. We denoted \( n_i \) and \( d_i \) as the refractive index and the thickness of the \( i \)th layer, respectively. \( \theta_i \) is the incident angle of light to the \( i \)th layer. \( \varepsilon_0 \) and \( \mu_0 \) are the permittivity and permeability of free space, respectively.

Using \( \sum_{i=1}^{N} M_i = m \), where \( M_i \) is the individual transfer matrix, the reflection coefficient \( r \) for transverse magnetic (TM)-polarized light is then expressed as:

\[
r = \frac{\gamma_N m_{11} + \gamma_0 \gamma_N m_{12} - m_{21} - \gamma \varrho m_{22}}{\gamma_N m_{11} + \gamma_0 \gamma_N m_{12} + m_{21} + \gamma \varrho m_{22}}
\]  

(4)

\[
t = \frac{2\gamma_0 \left(\frac{n_i}{n_0}\right)}{\gamma_N m_{11} + \gamma_0 \gamma_N m_{12} + m_{21} + \gamma \varrho m_{22}}
\]  

(5)

Then, the field enhancement is given by

\[\frac{I_2}{I_1} = \left|\frac{E_{21}}{E_{11}}\right|^2 .\]