

Supplementary Materials

Fluorescence Enhancement via Dual Coupling of Dye Molecules with Silver Nanostructures

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Section S1. The simulation of optical reflectance versus incident angle in a Kretschmann configuration with a thin Ag film coated prism

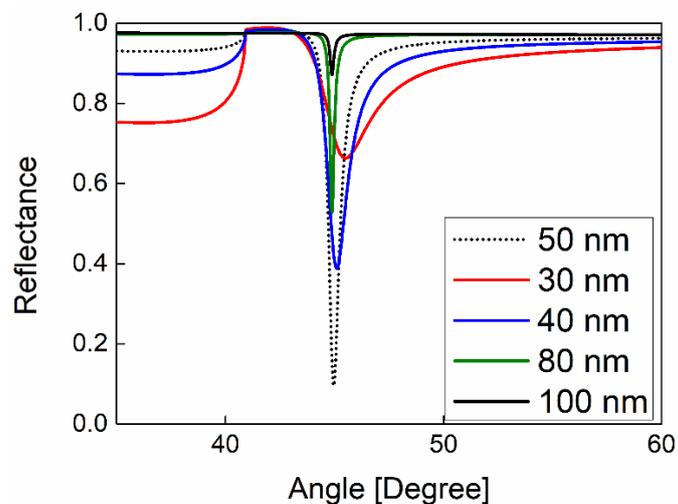


Figure S1. Reflectance versus incident angle curve in a Kretschmann configuration at 517 nm (10 nm MgF₂ layer/various thickness Ag film/soda-lime glass) for different thicknesses of Ag thin film in a Kretschmann configuration. The relevant optical parameter set is found in Section S3 of Supplementary Information.

Figure S1 presents the simulation results of optical reflection versus incident angles in an angle interrogating Kretschmann configuration for Ag thicknesses ranging from 30 nm to 100 nm. 50 nm thickness of the Ag film shows the largest depth-to-width ratio of the reflection dip.

Section S2: SEM images for surface of a Rhodamine 110 embedded SiO₂ layer

We take the SEM images of the SiO₂ layers to check the surface morphology. The chip that has Rhodamine 110 molecules dispersed in it shows the reasonably smooth surface as shown in Figure S2a. This supports the nearly uniform distribution of dye molecules within the SiO₂ layer. The image of surface of the chip that has both dye molecules and AgNPs internally embedded, shows the distribution of a clustered pattern of AgNPs as shown in Figure S2b. The enlarged inset view indicates that the inter-particle distance is in subwavelengths range within a clustered pattern.

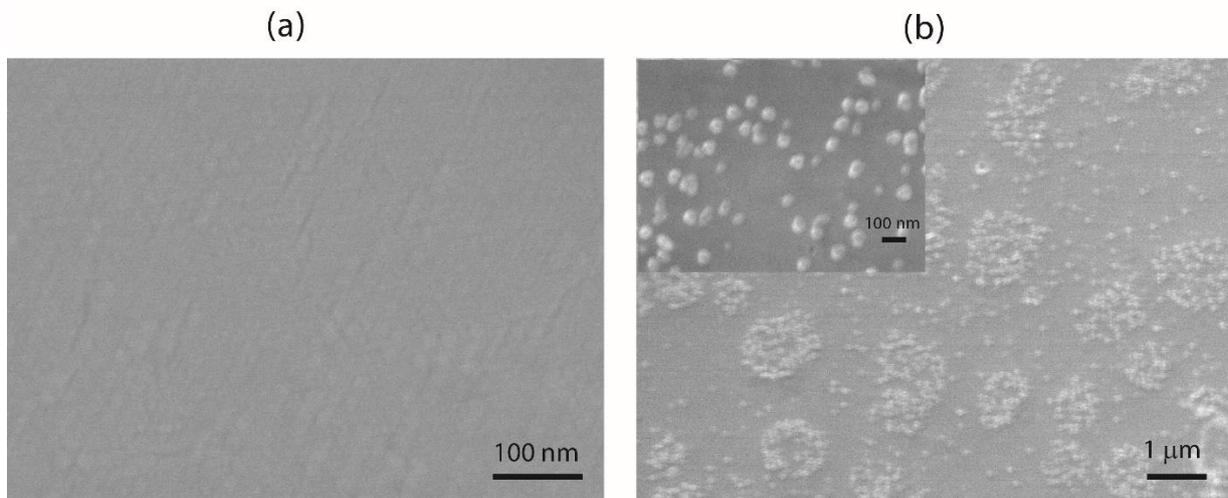


Figure S2. SEM images of SiO₂ layers. (a) dye molecules dispersed in the layer. (b) Both dye and AgNPs embedded in the layer.

Section S3: The optical parameter set used for optical reflectance as a function of incident angle in the Kretschmann configuration for Figure 5b and Figure S1.

Table S1. Dielectric constants of materials

Materials	Relative permittivity (ϵ_r)
	at $\lambda=517$ nm (Figure 5(b))
Silver (Ag) film	$-10.986+0.27938i$ [1]
MgF ₂	2.0266 [2]
SiO ₂	2.1535 [3]
Glass (soda lime glass-clear)	2.3317 [4]

As shown in Figure 1b2, the chip consists of a stack of the multilayers, i.e., a dye embedded SiO₂ layer, a 10 nm thick MgF₂ layer, and a 50 nm-thick Ag film, deposited on a slide glass (soda-lime glass). We assume the chip installed on a prism base in a typical Kretschmann configuration where incident light is prism-coupled to the chip via evanescent fields. We then calculate the electric field of reflected light as the incident angle is scanned, using the transfer matrix approach [5] commonly used for optical reflection from a stack of multilayers. Table S1 shows the complex relative permittivity of materials used in the calculation for Figures 4b and 5b.

References

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