Electronic Supplementary Material (ESI) for Nanoscale.

Supporting information for

Mode-specific study of nanoparticle-mediated optical interactions in an absorber/metal thin film system

Binxing Yu[1], Joseph Woo[2], Michael Kong[2], Deirdre M. O'Carroll[1,2]

[1]Rutgers University, Department of Chemistry and Chemical Biology, 610 Taylor Road, Piscataway, NJ 08854.

[2]Rutgers University, Department of Materials Science & Engineering, 607 Taylor Road, Piscataway, NJ 08854

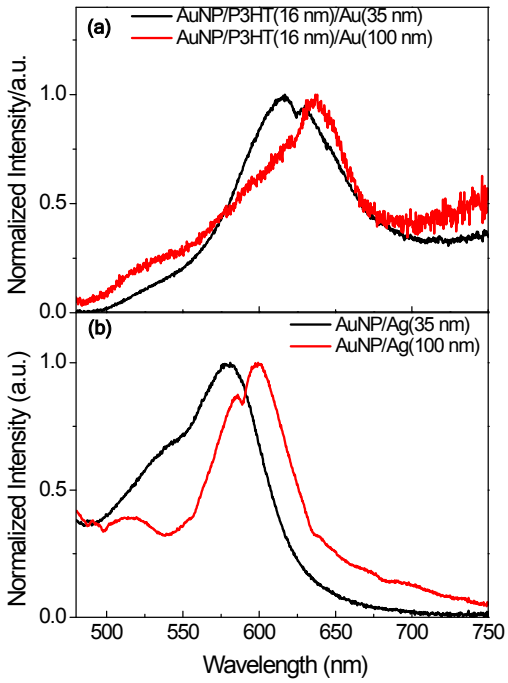

Figure S1. Single-particle dark-field spectroscopy of AuNP on (a) a thin P3HT spacer with underlying Au film of different thickness; (b) Ag film of different thickness. In both cases with the increase of thickness of underlying plasmonic metal substrate, the predominant peak at ~600 nm red shifts, which indicates a stronger interaction between vertically polarized LSPR and the image dipole.

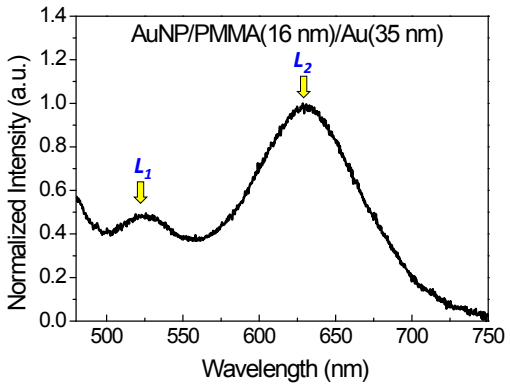

Figure S2. Measured dark-field scattering spectra for a single AuNP on a 16-nm-thick PMMA spacer on a 35-nm-thick Au film. The peak at ~535 nm and ~630 nm were attributed to L_1 and L_2 modes, respectively.

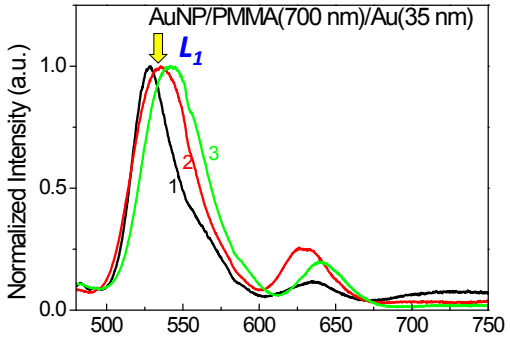

Figure S3. Measured scattering spectra for a single AuNP on a PMMA film with 700 nm thickness on a 35-nm-thick Au substrate. The spectra still consisted of two peaks. The peak at 535 nm was attributed to the LSPR peak of the AuNP (L_1). In this case, the polarizability of the PMMA still contributed a small shift relative to the value in aqueous solution. Also, since t_s here was comparable to the wavelength of incident light, we had to consider the possible effect of Fabry-Perot resonances. This may be the reason why the particle LSPR peak was so intense—the

cavity created by NP-film system was tuned to the resonance wavelength. The peak at around 630 nm was attributed to out-coupling of SPP modes on the Au film since hardly any interaction was expected between LSPR and SPPs at this distance.

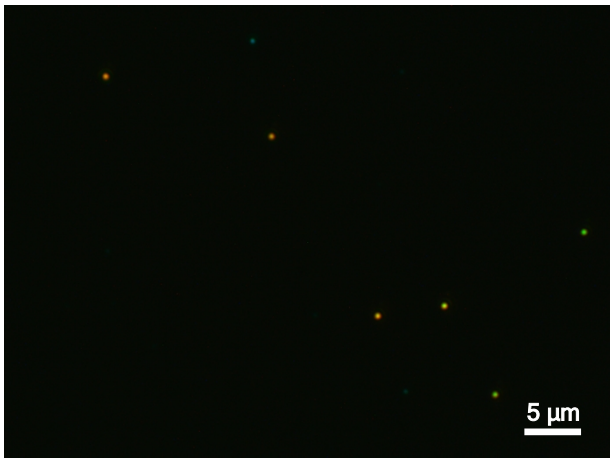

Figure S4. A representative dark-field image of AuNP/PMMA(16 nm)/Au film(35 nm). Both "green" and "red" particles can be observed. The formation of "red" particles in this case was attributed to the strong vertical image dipole coupling (L_2) which can exist at sub-20-nm spacer thickness.

	Green	Red
AuNP/glass	100.00%	0.00%
AuNP/Si	100.00%	0.00%
AuNP/Au film(35 nm)	90.90%	9.10%
AuNP/Au film(100 nm)	92.10%	7.90%
AuNP/PMMA(16 nm)/Au film(35 nm)	50.00%	50.00%
AuNP/PMMA(50 nm)/Au film(35 nm)	95.00%	5.00%
AuNP/P3HT(16 nm)/Au film(35 nm)	32.00%	68.00%
AuNP/P3HT(50 nm)/Au film(35 nm)	29.60%	70.40%
AuNP/P3HT(65 nm)/Au film(35 nm)	30.80%	69.20%

Table S1. The percentage of "red" and "green" particles in different sample sets. Data were taken over several random areas and, in total, over 50 NPs from each sample type were analyzed.