Supporting Information for

Refractive Index Susceptibility of Plasmonic Palladium Nanoparticle: Potential as the Third Plasmonic Sensing Material

Kosuke Sugawa,*[a] Hironobu Tahara,*[b] Ayane Yamashita,[a] Joe Otsuki,[a] Takamasa Sagara,[b] Takashi Harumoto[c], and Sayaka Yanagida[c]

[a]*College of Science and Technology, Nihon University, Chiyoda, Tokyo 101-8308, Japan*

[b]*Division of Chemistry and Materials Science, Graduate School of Engineering, Nagasaki University, Nagasaki 852-8521, Japan*

[c]*Department of Material Science and Technology, Tokyo University of Science, Katsushika, Tokyo 125-8585, Japan*

This file includes:

1) Supporting Figures S1–S4
2) Resonant condition of localized surface plasmon for a large nanoparticle

1) Supporting Figures S1–S4

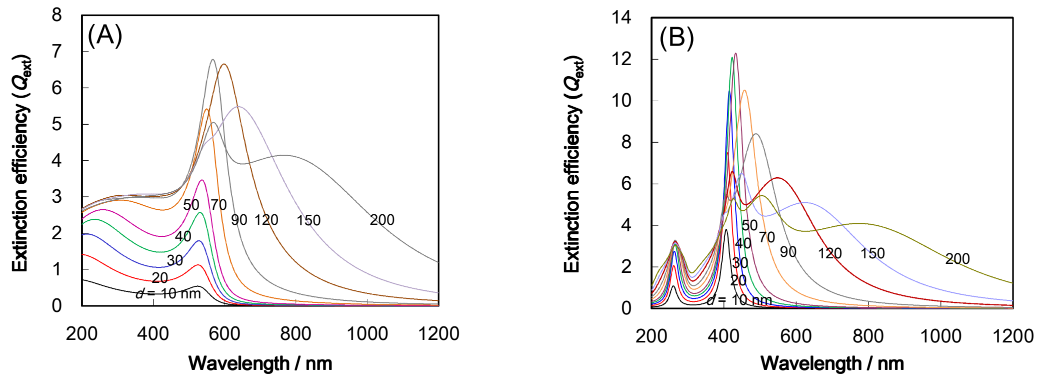

Figure S1 Calculated extinction spectra of AuNSs (A) and AgNSs (B) with the region of d = 10 – 200 nm surrounded by water (n = 1.333).

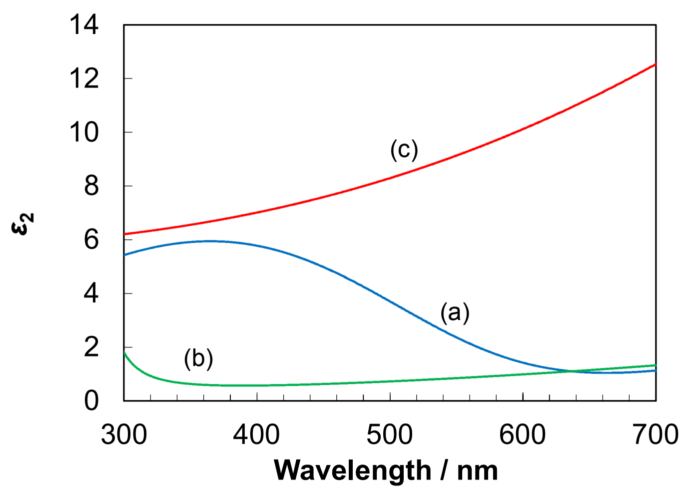

Figure S2 Wavelength dependences of imaginary part of the dielectric functions (ε_2) of Au (a), Ag (b), and Pd (c).

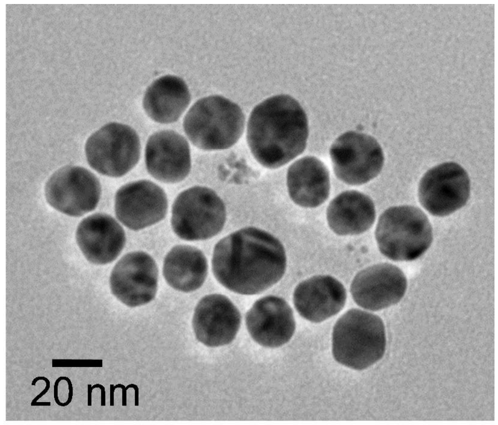

Figure S3 Transmission electron microscope (TEM) image of Au cores .

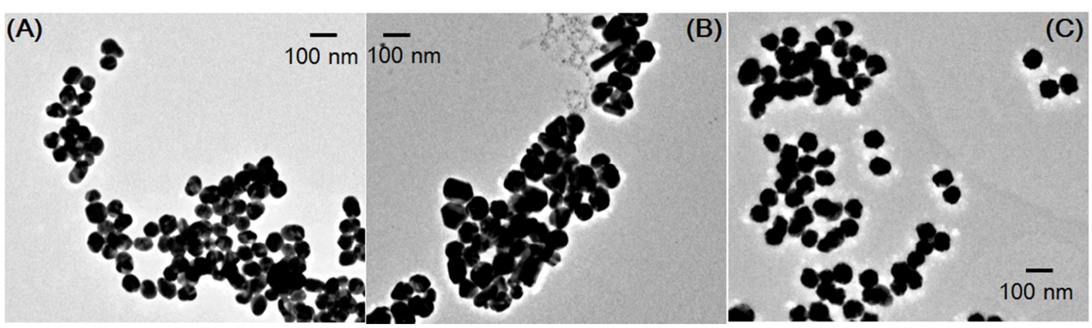

Figure S4. TEM images with low magnification of (A) AuNSs, (B) AgNSs, and (C) Au/PdNSs.

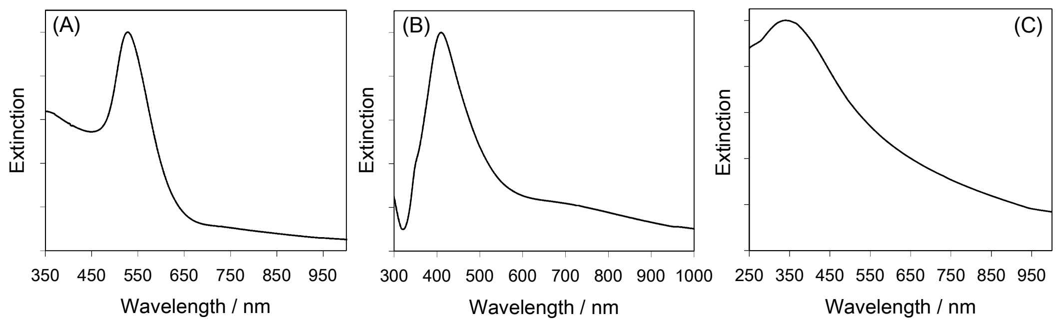

Figure S5 Extinction spectra in water for AuNSs (A), AgNSs (B), and Au/PdNSs (C)-immobilized quartz.

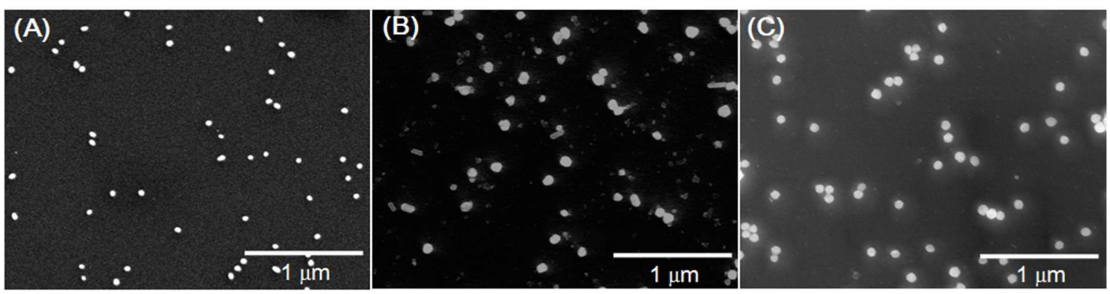

Figure S6. SEM images of (A) AuNSs, (B) AgNSs, and (C) Au/PdNSs immobilized on quartz substrates.

Table S1. Comparison of RI susceptibility of AuNSs, AgNSs, and Au/PdNSs obtained from the Mie theory (S_{Mie}).

Nanospheres	RI susceptibility (nm/RIU)	
	S_{Mie} (d = 73 nm)	S_{Mie}
AuNSs	148	126 (d = 60 nm)
AgNSs	242	230 (d = 70 nm)
PdNSs	351	351 (d = 73 nm)

2) Resonant condition of localized surface plasmon for a large nanoparticle

The resonant condition of surface plasmon for small particles is simply described by Fröhlich condition as mentioned in the main manuscript. However, the resonant condition for a large particle should be modified as follows[41]

$$\varepsilon_1 = -\left(2 + \frac{12}{5}x^2\right)n^2 \qquad \text{(S1)}$$

$$x = \frac{\pi d}{\lambda_0} \qquad \text{(S2)}$$

where x, d, λ_0 are the size parameter, the diameter of the sphere, and the LSPR wavelength, respectively. Table S1 shows the values of ε_1, which are corrected with the size parameters. It is clear from that the values of size parameters for the nanosphere sizes used in this study are sufficiently small such that the ε_1 values are not significantly affected. This estimate supports that the ε_1 is nearly independent of the kind of metals.

Table S2 Values of ε_1, which are corrected with the size parameters (x), of Au, Ag, and Pd for n_{bulk} = 1.37.

Metals	Mean diameter (d) (nm)	λ_0 (nm)	x	ε_1
Au	60	543	0.35	-4.3
Ag	70	466	0.47	-4.8
Pd	73	393	0.58	-5.3