Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supplementary material (ESI) for *J. Mater. Chem.C*

Supporting information for:

Optical Properties of SiO_2@M (M=Au, Pd, Pt) Core-shell Nanoparticles: Material Dependence, and Damping Mechanisms

Xuemin Zhang,*[a] Shunsheng Ye,[b] Xun Zhang,[c] Lianpeng Wu[c]

[a] *Department of Chemistry, College of Sciences, Northeastern University, Shenyang 110004, P. R. China, E-mail: zhangxuemin@mail.neu.edu.cn.*

[b] *State Key Lab of Supramolecular Structure and Materials, College of Chemistry, Jilin University, Changchun 130012, P. R. China.*

[c] *Jilin Entry-exit Inspection and Quarantine Bureau, Changchun 130062, P. R. China*

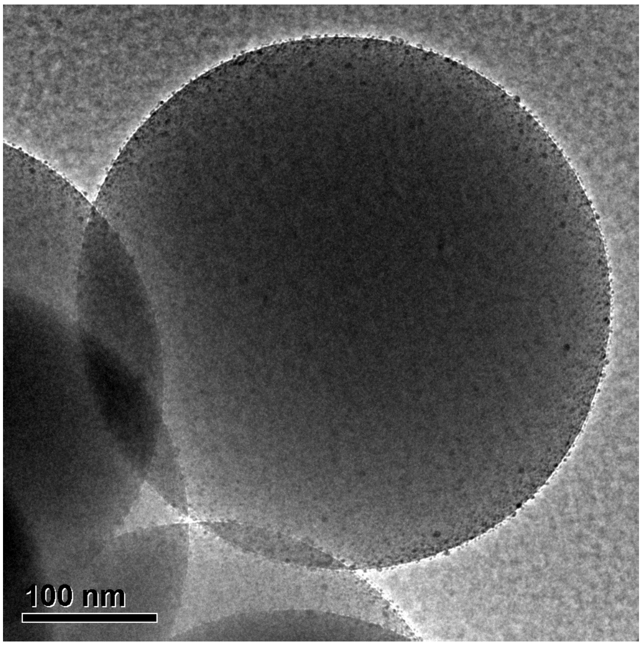

Figure S1. TEM image of gold-seeded silica core. It can be roughly estimated that the surface coverage of gold seeds is less than 30%.

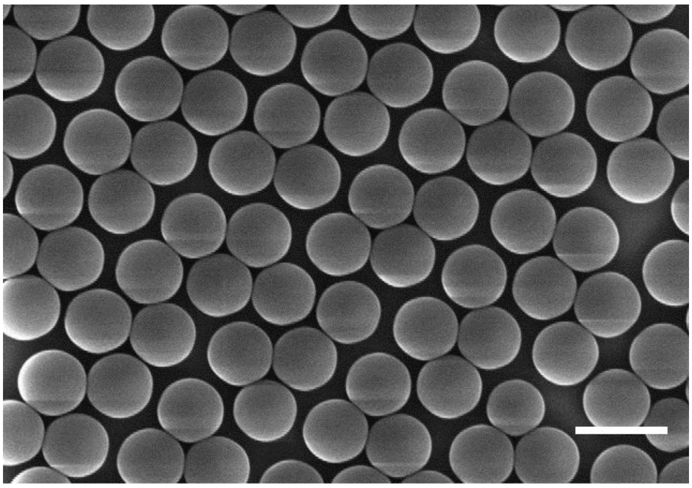

Figure S2. SEM image of silica nanospheres prepared by the Stöber method. Different from SiO_2@M core-shell NPs, their surface are clean and smooth. The scale bar represents 200 nm.

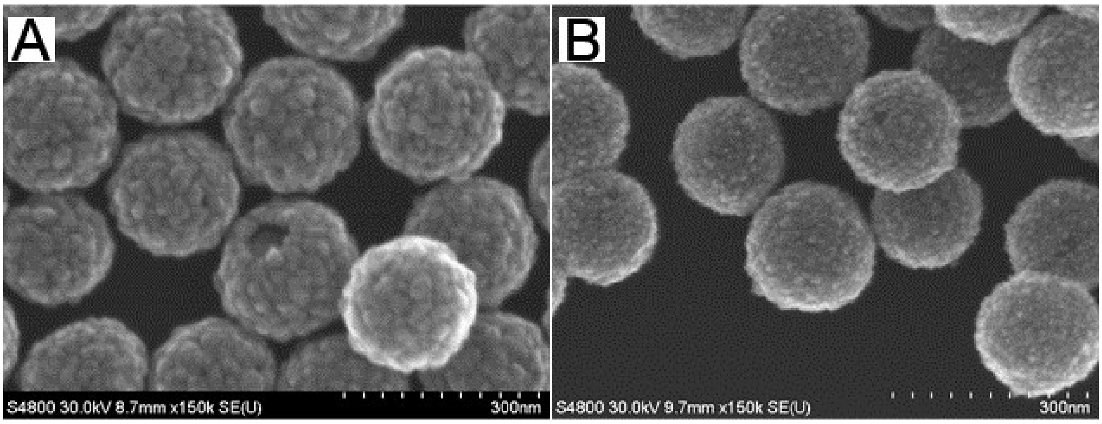

Figure S3. Magnified SEM images of SiO_2@Pd (A) and SiO_2@Pt (B) NPs. Both of their shell thicknesses are ~13nm.

Table S1. Statistical analysis of the relationship between the dipolar peak position[a], core size and gold shell thickness.

Gold shell thickness (nm)	Diameter of the SiO_2 Core (nm)				
	40	100	160	280	400
8	575				
10	563	707	836	1050	1256
15	540	658	755	994	1218
20	532[b]	618	720	956	1189
25	532	596	696	926	1179
30	532	601	689	916	1187
35	535	607	700	932	1210
40	537	617	735	960	1250

[a] in the ESI, the surrounding environment was set as air in the FDTD calculations.

[b] the peak position (nm) represented using red color indicates the crossover point.

Table S2. Statistical analysis of the relationship between the dipolar peak position[a], core size and Pd shell thickness.

Pd shell thickness (nm)	Diameter of the SiO_2 Core (nm)				
	40	100	160	280	400
5	375				
10	343	552	748	1195	1452
15	325[b]	496	681	1044	1407
20	325	479	657	1001	1357
25	337	485	659	957	1329
30	351	500	674	970	1338
35	377	532	703	995	1348
40		560	733	1036	1367

[a] in the ESI, the surrounding environment was set as air in the FDTD calculations.

[b] the peak position (nm) represented using red color indicates the crossover point.

Table S3. Statistical analysis of the relationship between the dipolar peak position[a], core size and Pt shell thickness.

Pt shell thickness (nm)	Diameter of the SiO_2 Core (nm)				
	40	100	160	280	400
5	388				
10	353	559	726	1068	1436
15	333[b]	505	665	994	1386
20	333	486	644	970	1338
25	342	489	650	972	1328
30	355	499	663	983	1328
35	374	538	700	1003	1347
40		562	738	1045	1357

[a] in the ESI, the surrounding environment was set as air in the FDTD calculations.

[b] the peak position (nm) represented using red color indicates the crossover point.

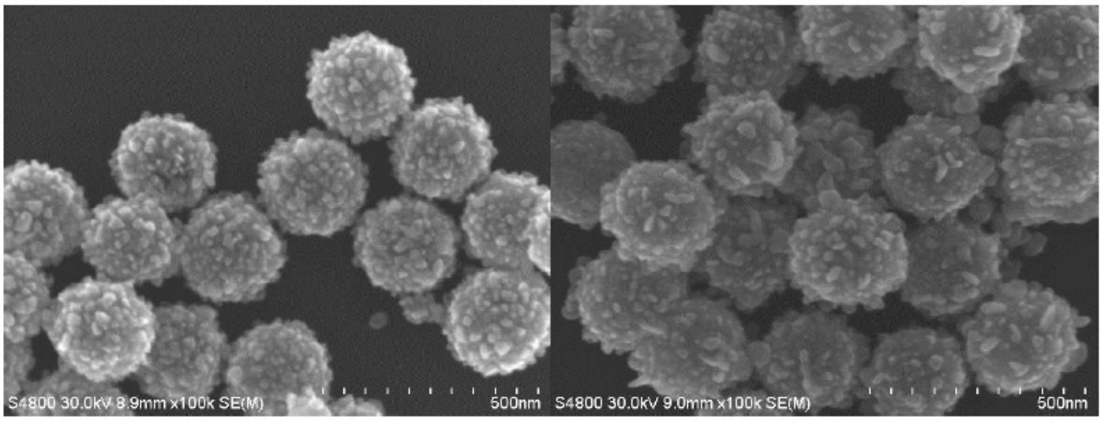

Figure S4. SiO_2@Au core-shell NPs with rough surfaces. The shell thickness are roughly 36 nm and 42 nm, respectively. Their corresponding extinction spectra are given in Figure 3B.

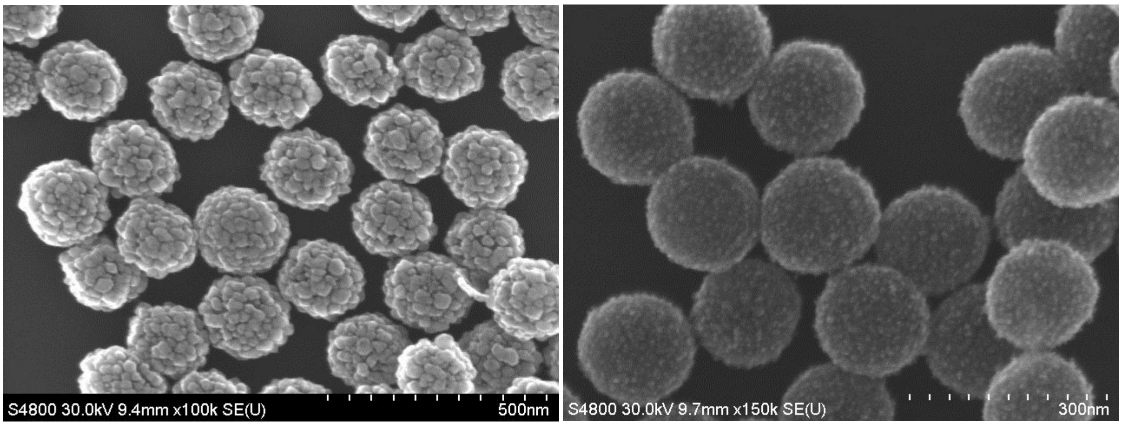

Figure S5. Pd (left) and Pt (right) nanoparticle decorated silica core.

The polarizability **α** of a metallic nanoshell can be represented using following *equation:*

$$\alpha = 4\pi a_2^3 \frac{(\varepsilon_2 - \varepsilon_m)(\varepsilon_1 + 2\varepsilon_2) + f(\varepsilon_1 - \varepsilon_2)(\varepsilon_m + 2\varepsilon_2)}{(\varepsilon_2 + 2\varepsilon_m)(\varepsilon_1 + 2\varepsilon_m) + f(2\varepsilon_2 - 2\varepsilon_m)(\varepsilon_1 - \varepsilon_2)}$$

(S1)

where a_1 is the inner radius, a_2 is the outer radius, $f = a_1^3/a_2^3$ being the fraction of the total particle volume occupied by the inner sphere; ε_1, ε_m and ε_2 are the dielectric constants of the core, shell and surrounding environment, respectively. From equation S1, it can be concluded that **α** will reach its maximum at the condition that the denominator equals 0. Because ε_1, ε_2, f are all real numbers and ε_m is a complex number, the presence of large imaginary part ε_i in the ε_m will greatly reduce the magnitude of **α**. For Pt and Pd, they exhibit a higher value of ε_i compared to Au (in the present spectral range, approximately 10 times larger). As a result, the polarizability **α** of a Pd and Pt nanoshells is much lower than that of Au nanoshells. In the meanwhile, it is also noted that **α** has a functional dependence on a_2^3, therefore, the crossover thickness generally increases with the increase of core sizes.