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Supporting Information

Gate tunable conductivity of hybrid gold nanocrystals – semiconducting matrix thin films

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Absorption Spectrum of Au NCs solutions

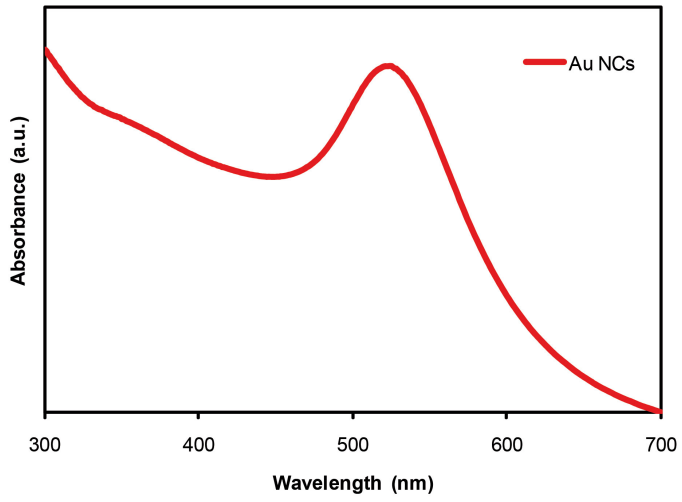

Figure S1. Absorption spectrum of Au NCs capped with original organic ligands in toluene.

The curve can be fitted with Mie theory[1], where the absorption coefficient is given by [2]:

$$\varepsilon(M^{-1}cm^{-1}) = \frac{18\pi 10^{-3} V_m \varepsilon_m^{3/2}}{2.303\lambda}\left[\frac{\varepsilon_2}{(\varepsilon_1 + 2\varepsilon_m)^2 + \varepsilon_2^{\,2}}\right]$$

where the parameters for Au NCs are : V_m =10.21 cm^3 mol^{-1}, ε_1 = 1.61 and ε_2 = -1.94 dispersed in toluene with dielectric coefficient ε_m = 1.4969. From this equation, the concentration of NCs in solution has been calculated with the following fixed parameters: sphere diameter = 5.3 nm, λ = 400 nm.

XRD Peak list for JPCDS card 00-023-0677

No.	h	k	l	d [A]	2Theta[deg]	I [%]
1	0	0	1	5.89000	15.029	100.0
2	1	0	0	3.16200	28.200	30.0
3	0	0	2	2.95100	30.262	5.0
4	1	0	1	2.78400	32.125	55.0
5	1	0	2	2.15500	41.887	25.0
6	0	0	3	1.96650	46.122	5.0
7	1	1	0	1.82400	49.961	30.0
8	1	1	1	1.74310	52.452	20.0
9	1	0	3	1.66930	54.962	8.0
10	2	0	0	1.58010	58.353	4.0
11	1	1	2	1.55210	59.510	4.0
12	2	0	1	1.52630	60.621	8.0
13	0	0	4	1.47490	62.970	4.0
14	2	0	2	1.39280	67.154	5.0
15	1	1	3	1.33740	70.335	6.0
16	2	0	3	1.23140	77.445	2.0
17	2	1	0	1.19420	80.336	2.0
18	0	0	5	1.17990	81.514	1.0
19	2	1	1	1.17050	82.309	5.0
20	1	1	4	1.14690	84.387	7.0
21	2	1	2	1.10690	88.199	5.0
22	1	0	5	1.10500	88.390	5.0
23	2	0	4	1.07780	91.237	1.0
24	3	0	0	1.05340	93.983	4.0
25	3	0	1	1.03700	95.944	2.0
26	2	1	3	1.02080	97.982	3.0
27	1	1	5	0.99090	102.042	2.0
28	0	0	6	0.98320	103.157	1.0
29	2	0	5	0.94540	109.133	1.0
30	1	0	6	0.93850	110.325	1.0
31	3	0	3	0.92850	112.119	2.0
32	2	2	0	0.91210	115.244	2.0
33	2	2	1	0.90150	117.401	2.0
34	3	1	0	0.87620	123.077	1.0
35	2	2	2	0.87150	124.228	1.0
36	3	1	1	0.86690	125.388	2.0
37	3	0	4	0.85710	127.983	3.0
38	3	1	2	0.84000	132.990	3.0
39	2	1	5	0.83930	133.210	3.0

Ellipsometry studies:

Ellipsometric measurements were performed on thin films deposed by spin coating on silicon wafer with a 25 nm SiO_2 layer.

Thickness measurements.

All thickness measurements were made with a laser (658 nm) as incident light and the ellipsometry parameters (Δ and Ψ) were collected with incident angles in the range of 45 to 80 degree (red and blue points).

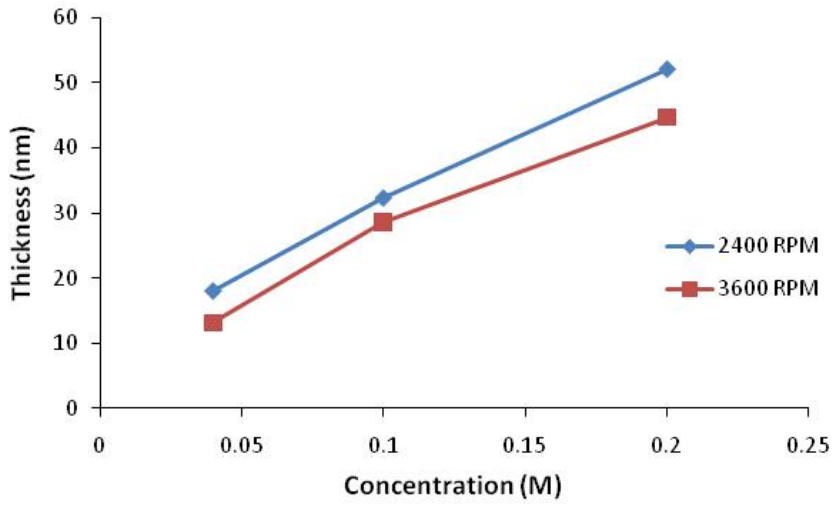

Figure S2. Film thickness as function of MCCs concentration spin coated at speed of 2400 and 3600 RPM.

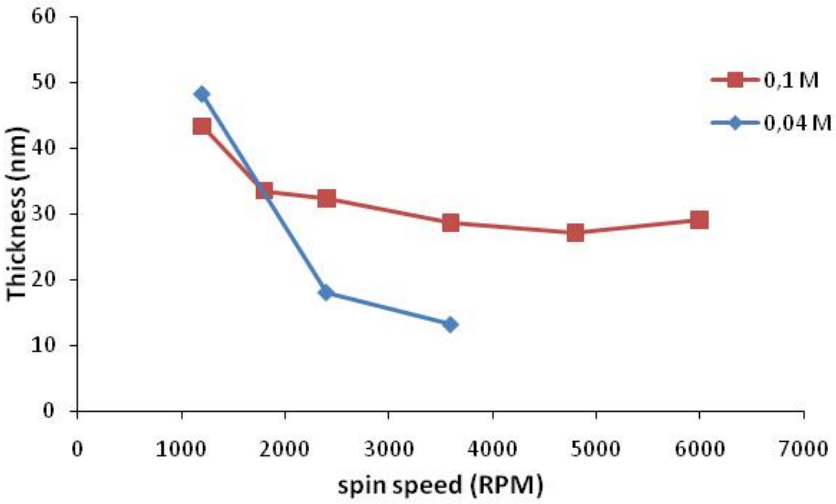

Figure S3. Film thickness as function of spin coating speed

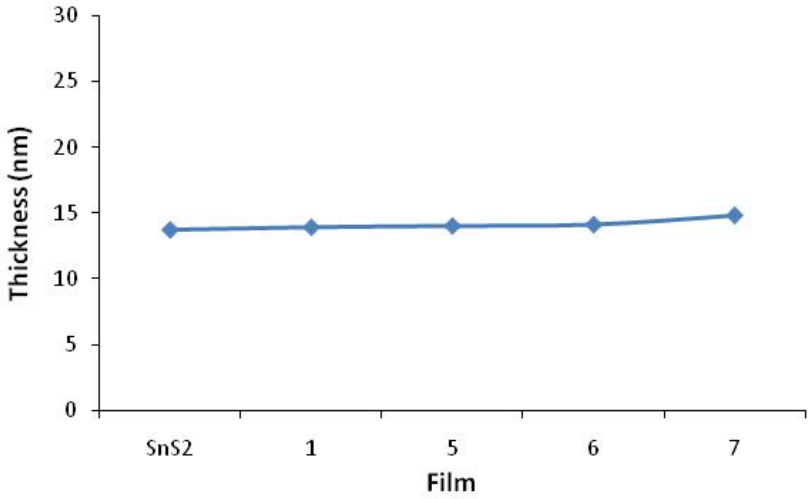

Figure S4. Film thickness as function of Au NCs concentration

SEM characterization of the films

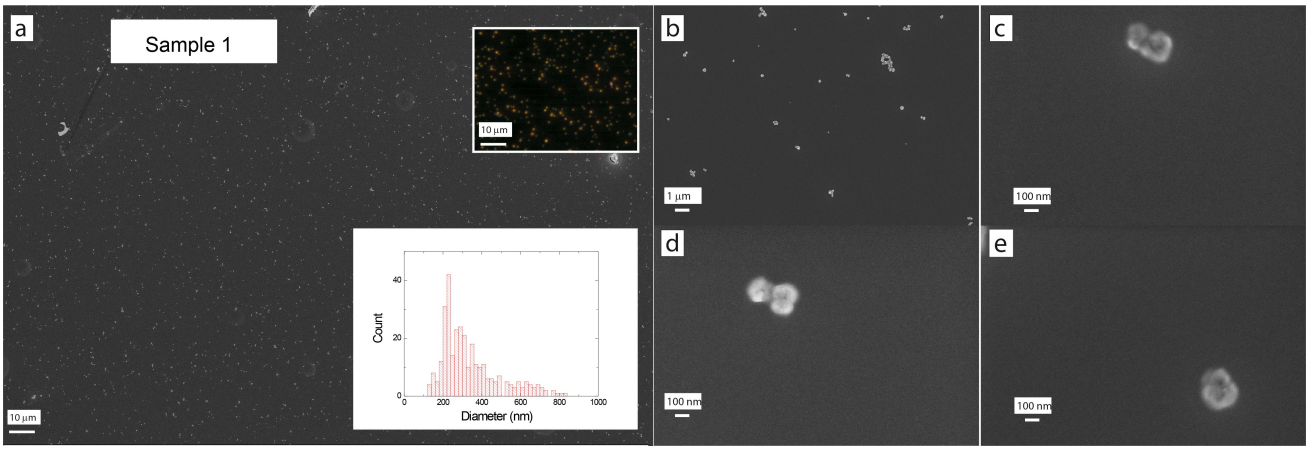

Figure S5. Images of Sample 1. Panel (a): Main panel, SEM image at magnification x500. Inset: Dark optical image shown at the same scale and size distribution of the Au NCs clusters with average size about 230 nm. Panel (b): Main panel, SEM image at magnification x5000. Panels (c) to (e) are SEM images at x50K of individual clusters.

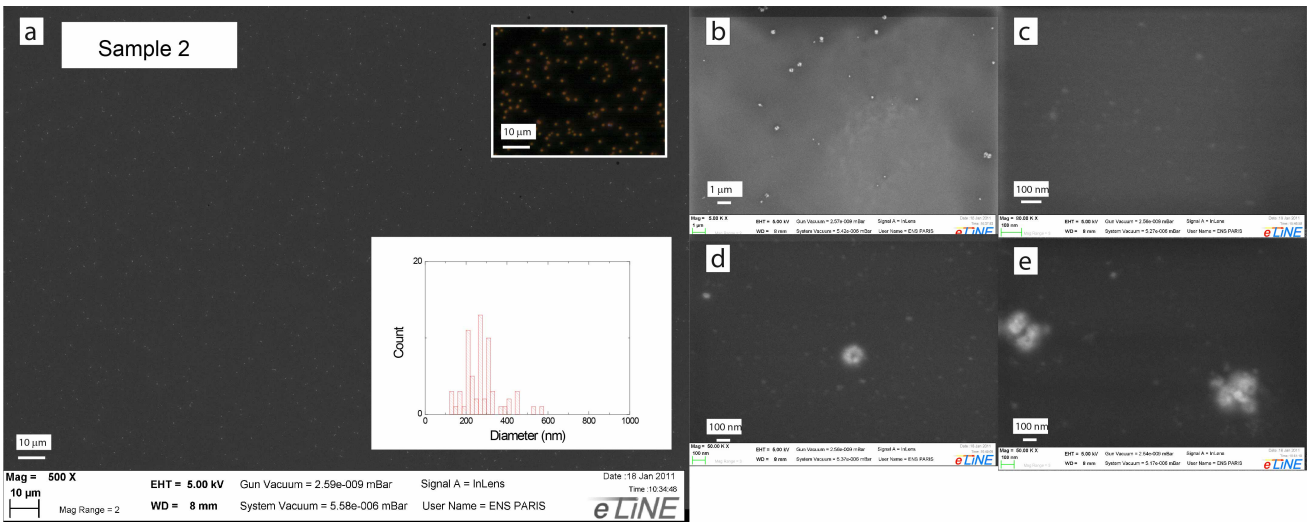

Figure S6. Panels a) to e) SEM images of sample 2. Insets : Dark field optical image and histogram.

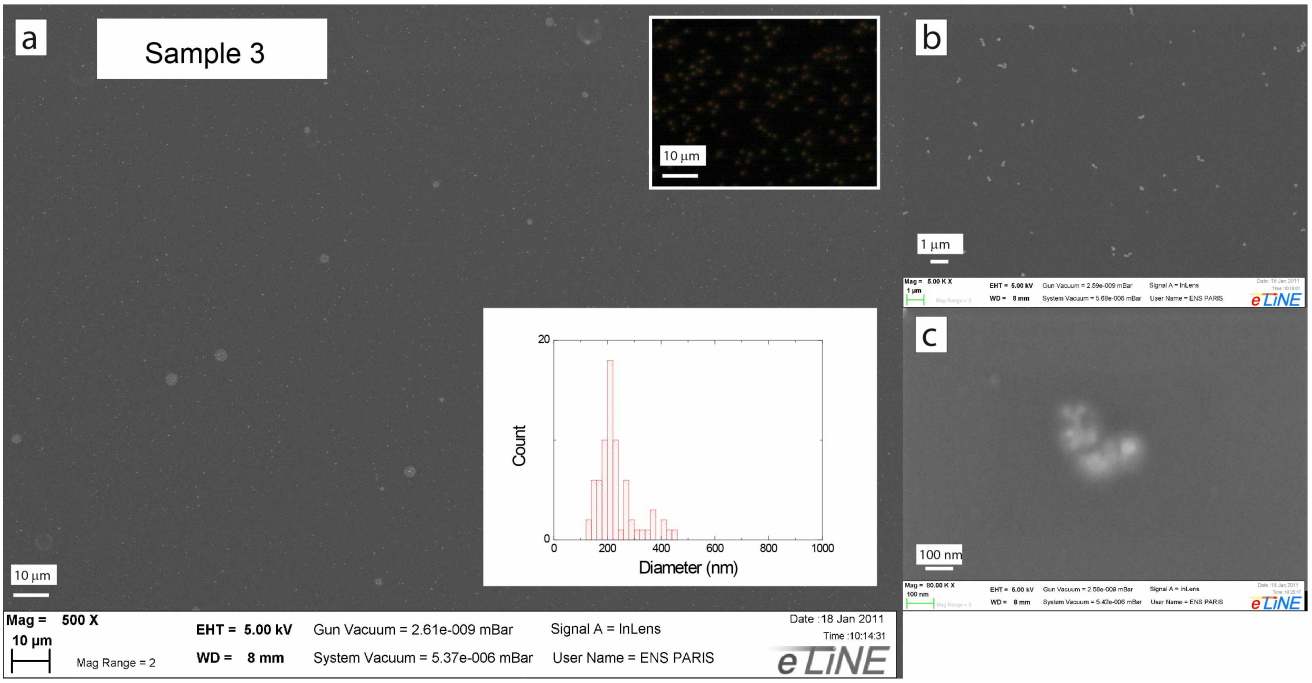

Figure S7. Panels a) to c) SEM images of sample 3. Insets : Dark field optical image and histogram.

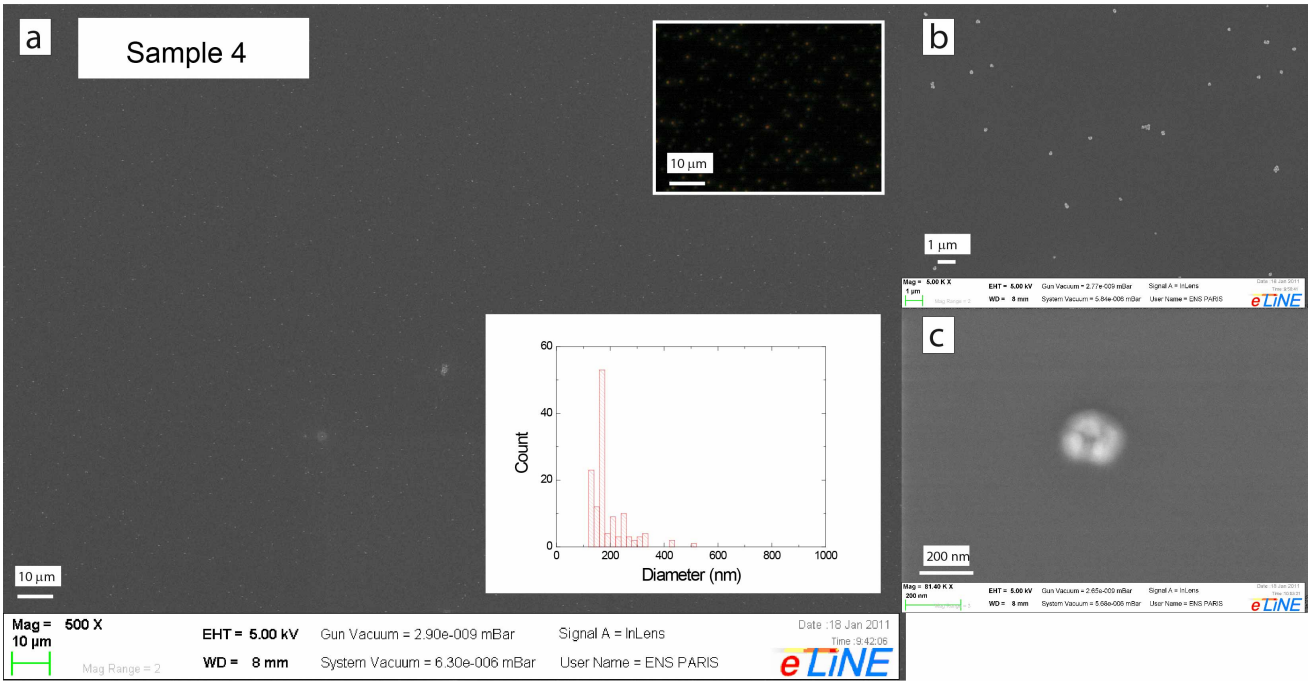

Figure S8. Panels a) to c) SEM images of sample 4. Insets : Dark field optical image and histogram.

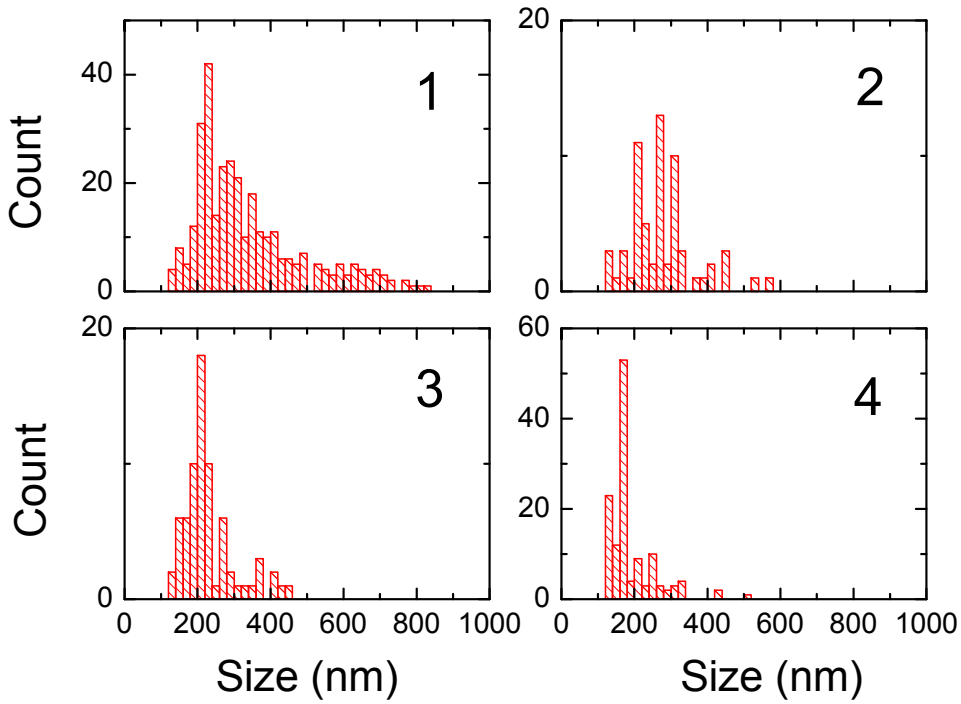

Figure S9. Size histogram obtained from the analysis of the clusters observed in SEM pictures. For decreasing concentration of Au NCs in solution, the mean size tends to decrease and the distribution narrows.

REFERENCES

(1) Mie, G. *Annalen der Physik* **1908**, 377-445.

(2) Ung, T.; Liz-Marzán, L. M.; Mulvaney, P. *The Journal of Physical Chemistry B* **2001**, *105*, 3441-3452.