Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information

Investigating Lattice Strain Impact on the Alloyed Surface of Small Au@PdPt Core-Shell Nanoparticles

Benjamin P. Williams†, Momo Yaguchi†, Wei-Shang Lo, Chen-Rui Kao#, Leo K. Lamontagne, Brian T. Sneed, Casey N. Brodsky, Lien-Yang Chou, Chun-Hong Kuo#,*, and Chia-Kuang Tsung*

Department of Chemistry, Merkert Chemistry Center, Boston College, 2609 Beacon Street, Chestnut Hill, Massachusetts 02467, United States.

#Institute of Chemistry, Academia Sinica, No. 128, Section 2, Academia Rd, Nangang District, Taipei City, Taiwan 115.

†These authors contributed equally to this work.

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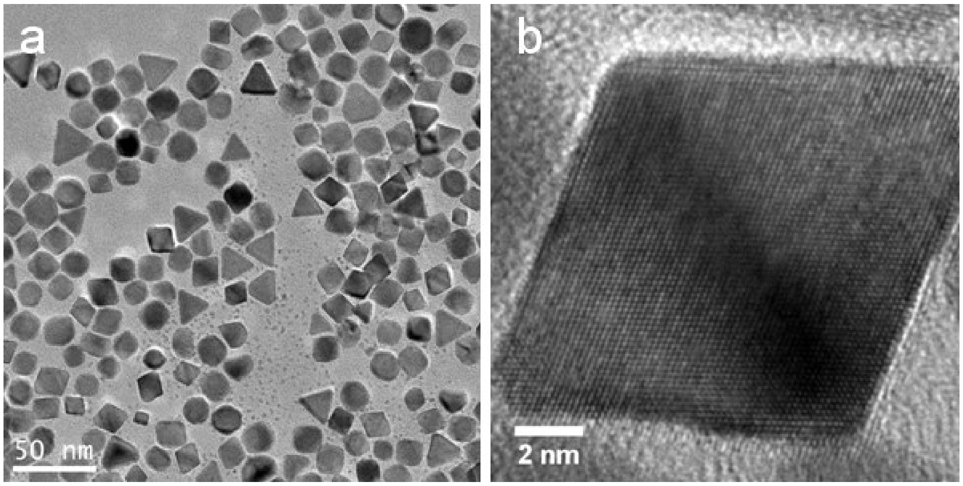

Figure S1. TEM images of Pd_1Pt_1 nanoparticles made by bubbling with oxygen gas.

Most particles are octahedral but larger in size than those made with argon bubbling, suggesting that the slow reaction rate allows {111} crystal facets to dominate during particle growth.

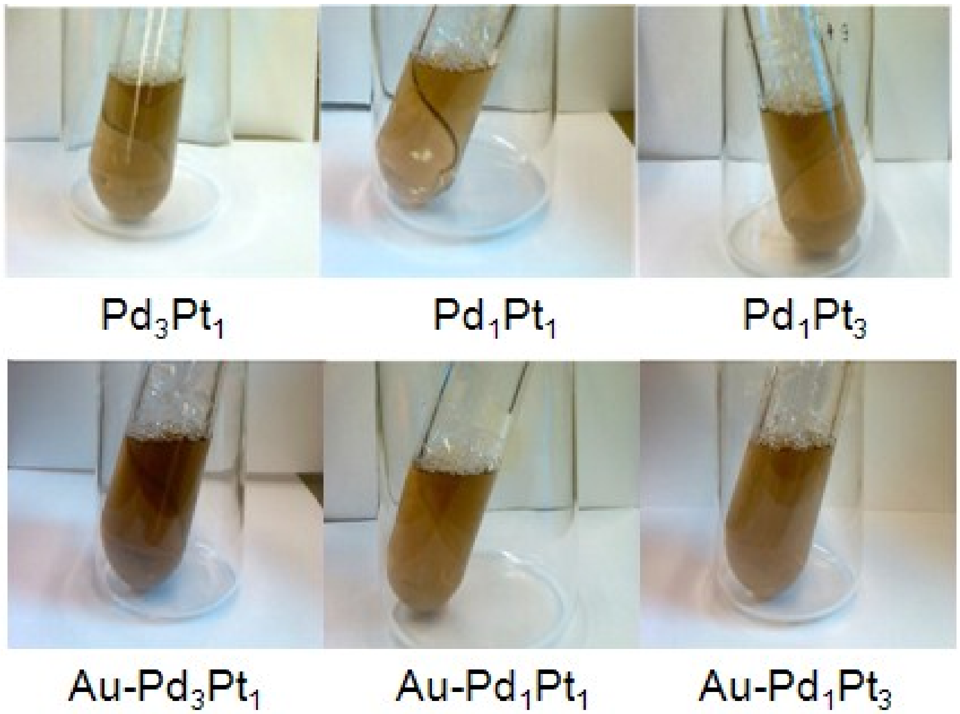

Figure S2. Photographs of alloy and core-alloyed shell octahedral nanoparticles.

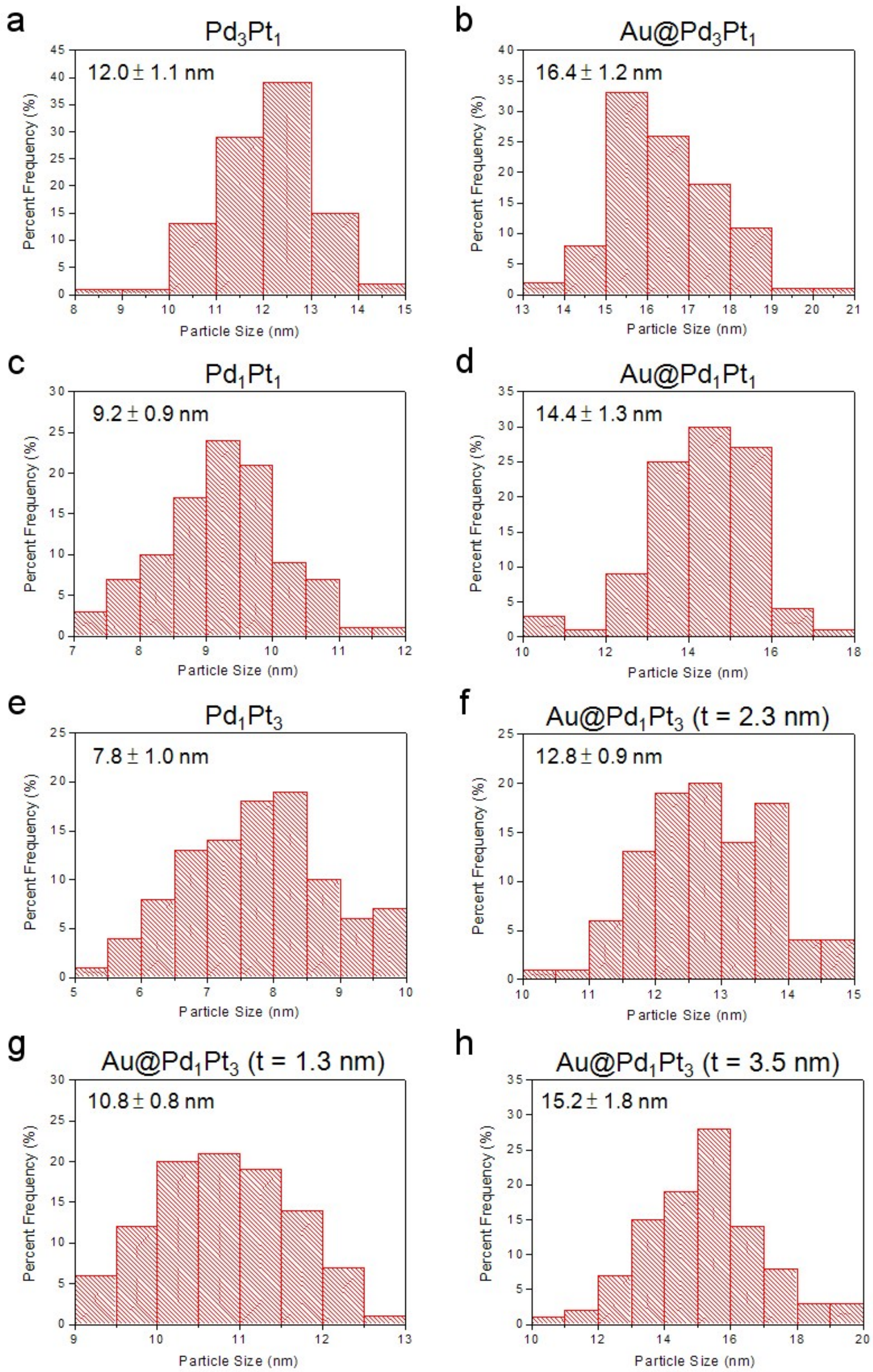

Figure S3. Size dispersions of alloy and core-alloyed shell nanoparticles. Histograms of (a, c, e) PdPt alloy and (b, d, f) Au-PdPt core-alloyed shell nanoparticles, with (f-h) representing the Au-Pd$_1$Pt$_3$ core-shell nanoparticles with different thicknesses.

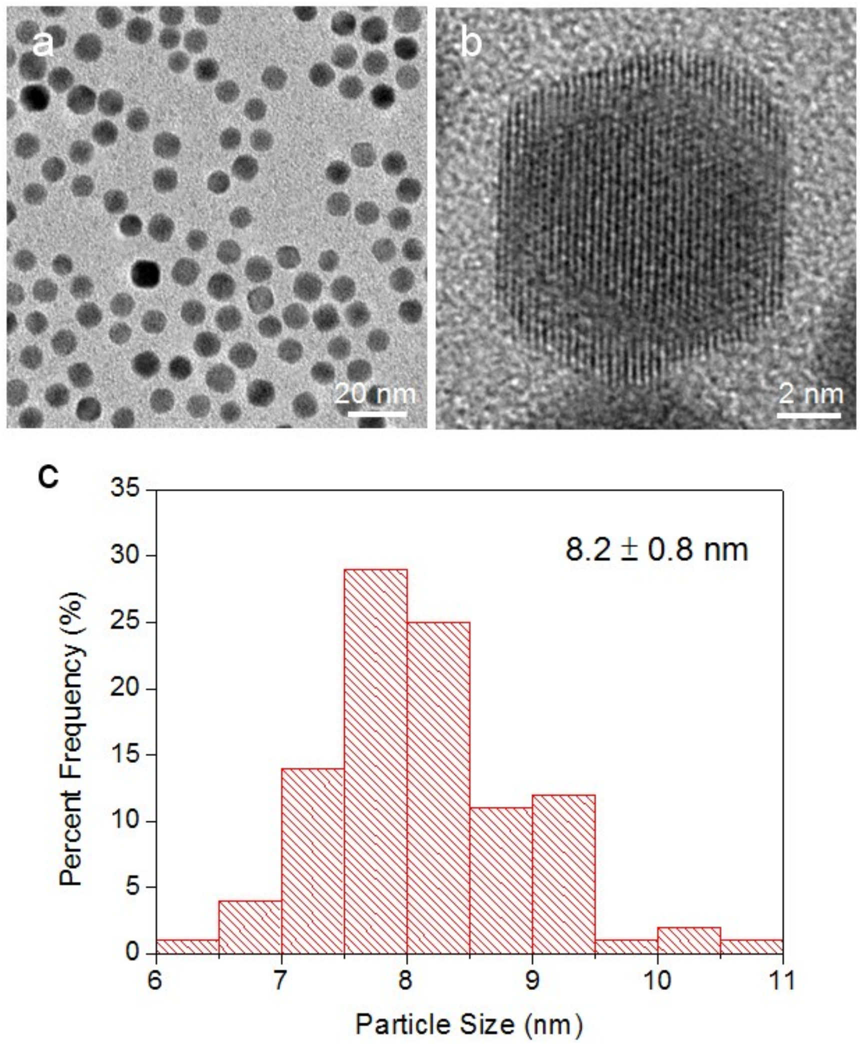

Figure S4. Analysis of the Au seeds.
TEM images and histogram showing the octahedral Au seeds are 8.2 nm and truncated on their corners.

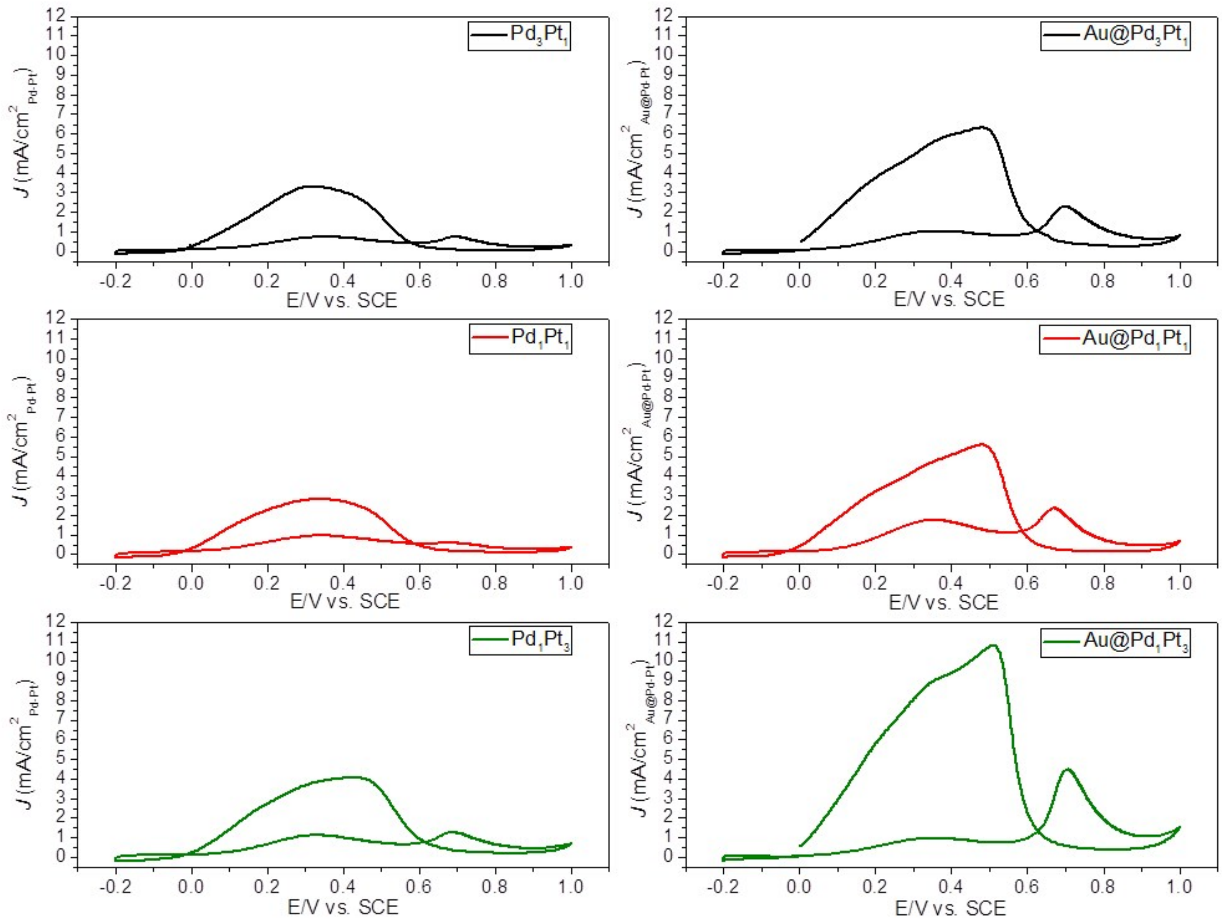

Figure S5. Formic acid oxidation cyclic voltammograms for Pd:Pt study.

Polarization curves of formic acid oxidation on PdPt alloy and Au-PdPt core-shell octahedral nanoparticles.

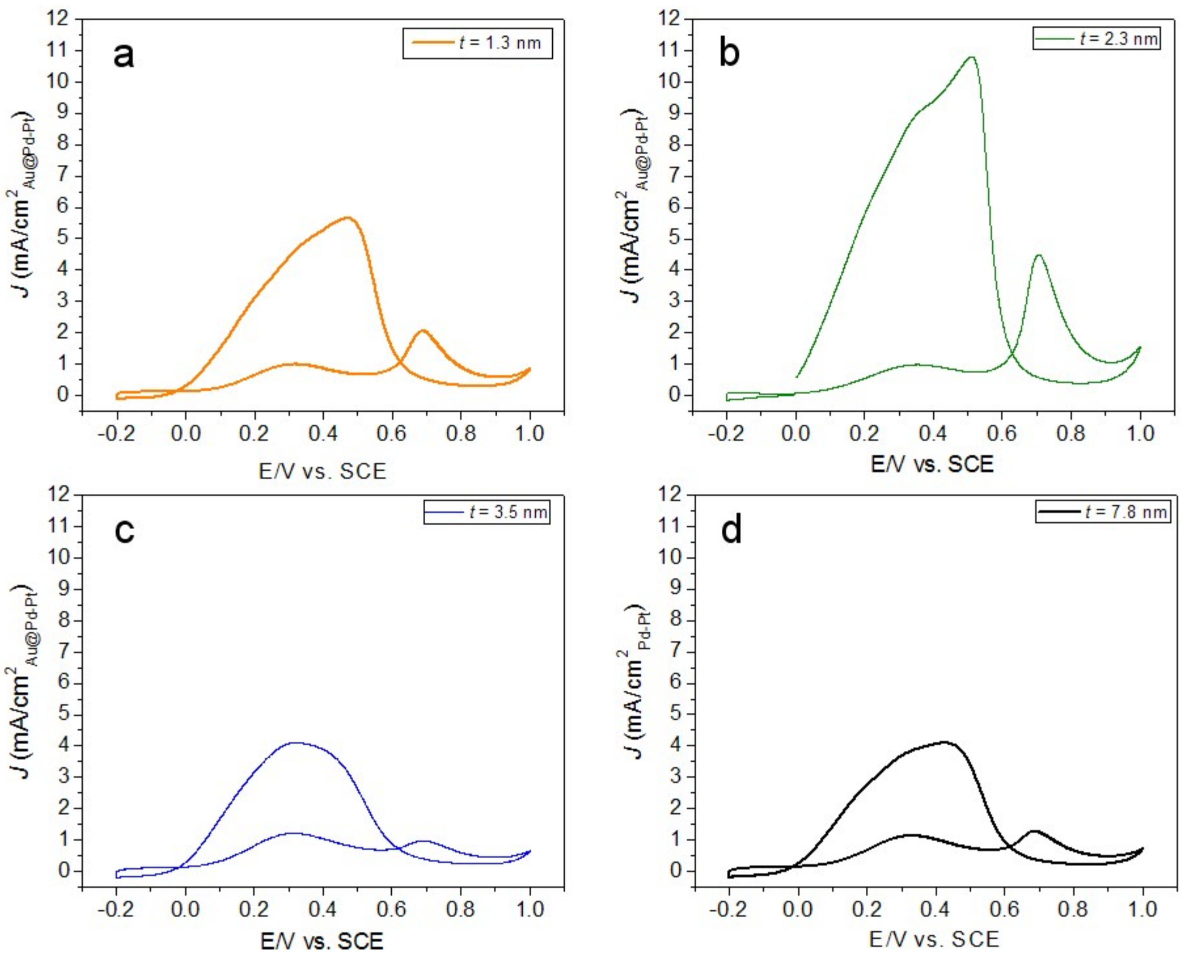

Figure S6. Formic acid oxidation cyclic voltammograms for thickness study.
Polarization curves of formic acid oxidation on Au-Pd_1Pt_3 core-shell nanoparticles with thickness (a) 1.3 nm, (b) 2.3 nm), (c) 3.5 nm, and Pd_1Pt_3 alloy nanoparticles with the size (d) 7.8 nm.

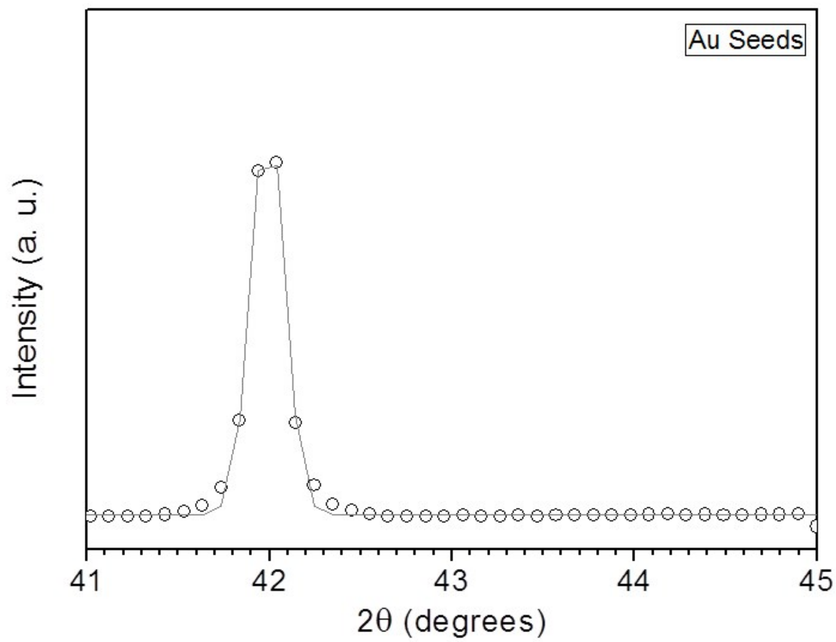

Figure S7. Synchrotron-based XRD analysis of Au seeds.
Synchrotron-based XRD pattern of Au seeds with (220) peak standing at 42.09°.

Table S1. EDS-analyzed composition of octahedral alloy nanoparticles.

molar ratio (Pd^{2+} : Pt^{2+})	**Pd (atomic %)**	**Pt (atomic %)**	**Composition**
3:1	19.39	7.56	$Pd_{2.6}Pt_{1.0}$
1:1	13.45	13.12	$Pd_{1.0}Pt_{1.0}$
1:3	5.60	13.10	$Pd_{1.0}Pt_{2.4}$

Table S2. EDS-analyzed composition of octahedral Au-PdPt core-shell nanoparticles.

molar ratio (Pd^{2+} : Pt^{2+})	Pd (atomic %)	Pt (atomic %)	Composition
3:1	20.08	7.39	$Au@Pd_{2.7}Pt_{1.0}$
1:1	18.18	14.22	$Au@Pd_{1.3}Pt_{1.0}$
1:3	6.03	15.12	$Au@Pd_{1.0}Pt_{2.5}$

Table S3. Composition of Au-Pd_1Pt_3 core-shell octahedral nanoparticles with different thickness.

Thickness (nm)	Pd (atomic %)	Pt (atomic %)	Composition
1.3	1.80	5.21	Au@$Pd_{1.0}Pt_{2.9}$
2.3	6.03	15.12	Au@$Pd_{1.0}Pt_{2.5}$
3.5	3.34	8.23	Au@$Pd_{1.0}Pt_{2.5}$

Table S4. Lattice parameters and strain of Pd, Pt, Pd1Pt3 alloy, and Au-Pd1Pt3 core-shell nanoparticles with different shell thickness.

Pd[a]	**Pt**[b]	**$Pd_1Pt_{2.4}$ (7.8 nm)**		**Au-$Pd_1Pt_{2.5}$ (3.5 nm)**		**Au-$Pd_1Pt_{2.5}$ (2.3 nm)**		**Au-$Pd_1Pt_{2.9}$ (1.3 nm)**	
a°_{Pd}	a°_{Pt}	a°_{PdPt}[c]	a_{PdPt}[d]	a°_{PdPt}	a_{PdPt}	a°_{PdPt}	a_{PdPt}	a°_{PdPt}	a_{PdPt}
3.867*	3.920	3.904	3.903	3.905	3.915	3.905	3.925	3.906	3.940
		δ_S[e] = –0.02 %		δ_S = 0.26 %		δ_S = 0.51 %		δ_S = 0.87 %	

* All lattice parameters are given in Å.

a, b Lattice parameters a°_{Pd} and a°_{Pt} are referred to x-ray diffraction database no. 87-0645 and no. 87-0646.

c a°_{PdPt} of the alloy Pd_xPt_{1-x} is the estimated lattice parameter got by Vegard's law in which a°_{PdPt} is the sum of xa°_{Pd} and $(1-x)a^{\circ}_{Pt}$.

d a_{PdPt} is the experimental lattice parameter obtained from (220) peaks in synchrotron-based XRD patterns.

e δ_S is lattice strain calculated by $[(a_{PdPt} - a^{\circ}_{PdPt})/ a^{\circ}_{PdPt}] \times 100$ (%).