Electronic Supplementary Material (ESI) for Catalysis Science & Technology.

Supplementary Information

Oxygen Reduction Reaction on Core@Shell Nanostructured Au-*d*@Ni_mPt_m: Effect of Core Size and Shell Thickness

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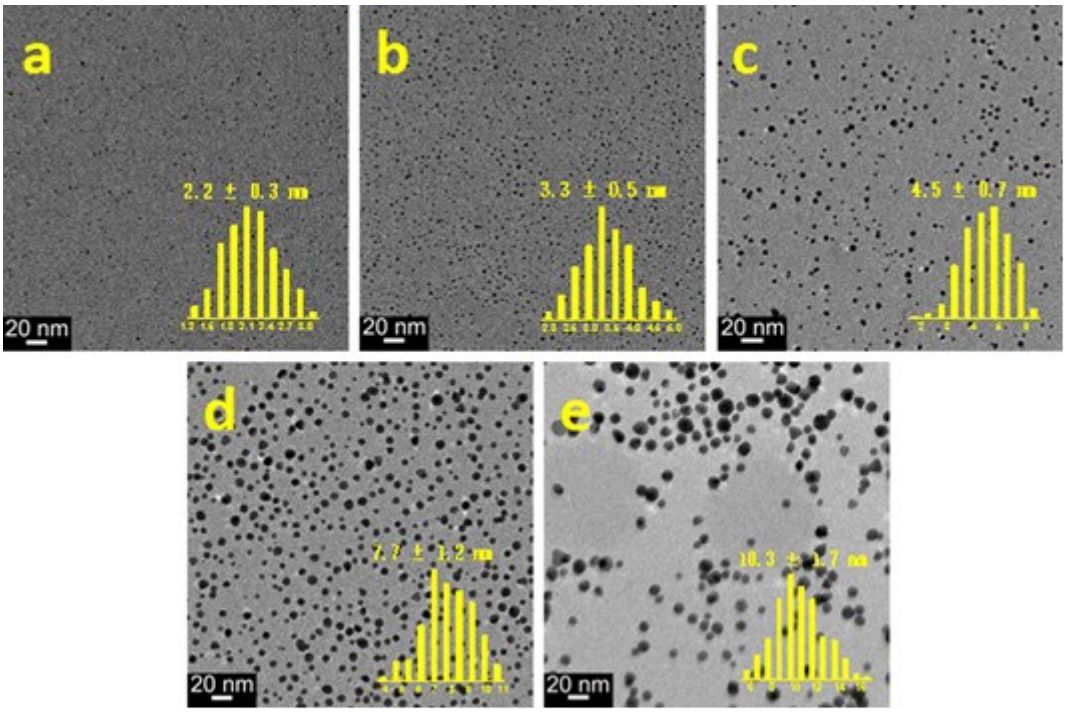

Figure S1. TEM images of (a) ($Pt_{0.15}$^Au-2.2)@Ni_2Pt_2/C, and (b) ($Pt_{0.25}$^Au-2.2)@Ni_2Pt_2/C.

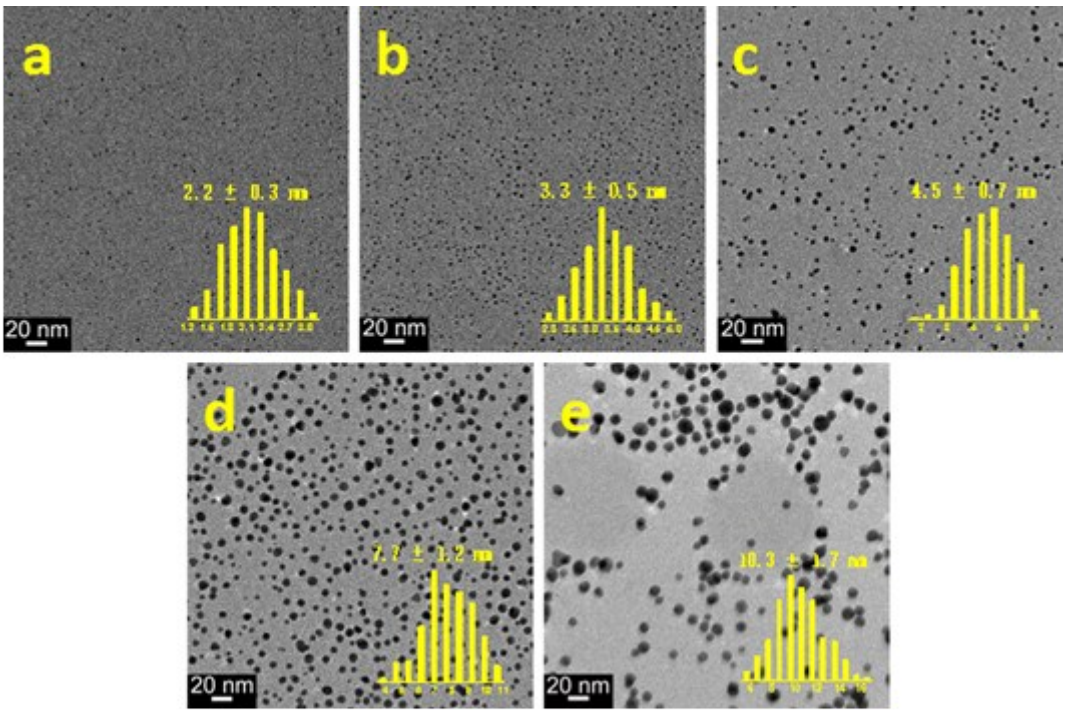

Figure S2. TEM images and their measured size histograms in diameter of Au-***d*** NPs: (a) ***d*** = 2.2, (b) ***d*** = 3.3, (c) ***d*** = 4.5, (d) ***d*** = 7.7, (e) ***d*** = 10.3.

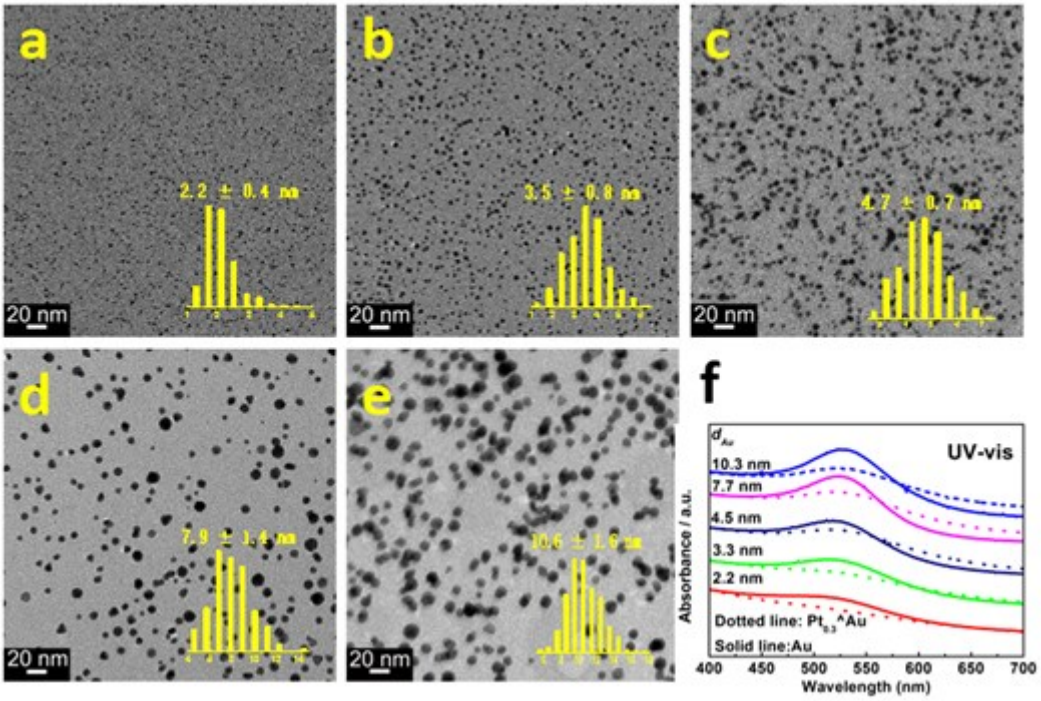

Figure S3. (a) $Pt_{0.3}$^Au-2.2, (b) $Pt_{0.3}$^Au-3.3, (c) $Pt_{0.3}$^Au-4.5, (d) $Pt_{0.3}$^Au-7.7, (e) $Pt_{0.3}$^Au-10.3. (f) UV−vis spectra of Au-***d*** NPs and $Pt_{0.3}$^Au-***d*** NPs.

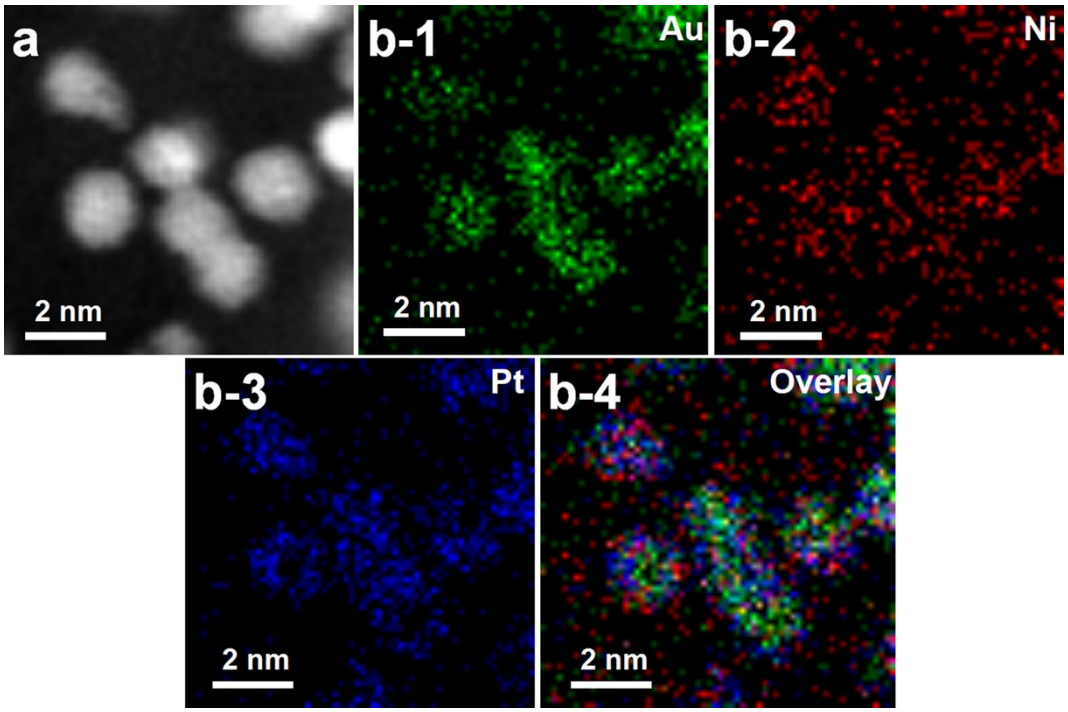

Figure S4. Structure and elemental analysis of as-prepared Au-2.2@$Ni_{0.5}Pt_{0.5}$ NPs. (a) HAADF-STEM images and (b) elemental distribution analysis, elemental mapping of Au (green), Ni (red), Pt (blue) and their overlay.

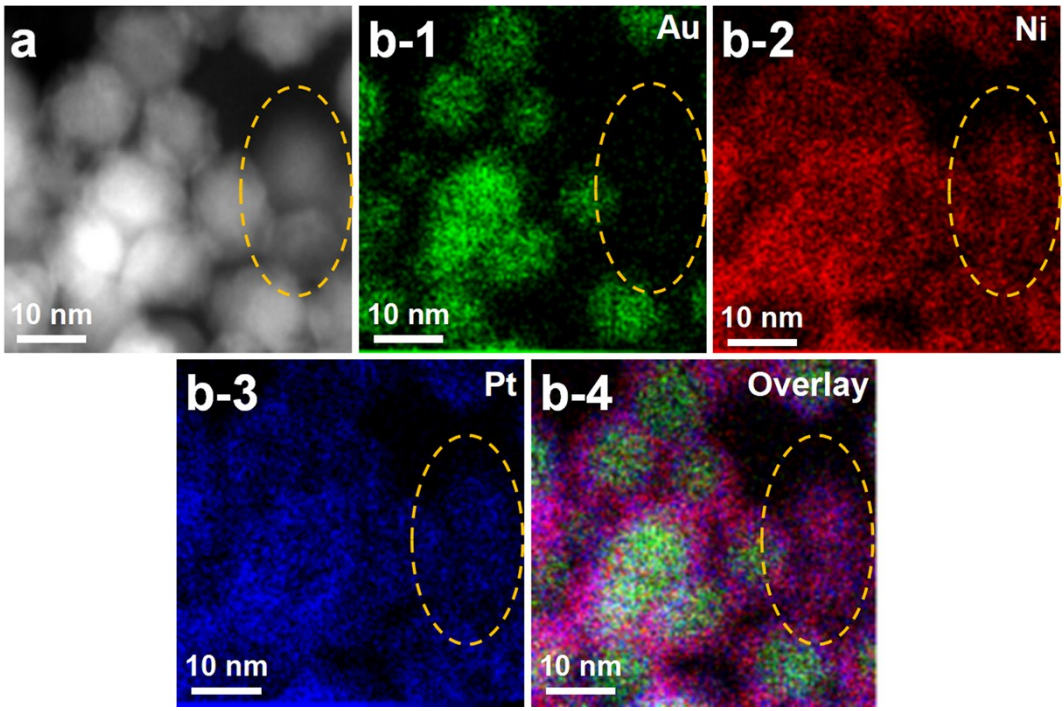

Figure S5. Structure and elemental analysis of as-prepared Au-10.3@Ni_2Pt_2 NPs. (a) HAADF-STEM images and (b) elemental distribution analysis, elemental mapping of Au (green), Ni (red), Pt (blue) and their overlay. The NPs without Au core were marked in the yellow ellipses.

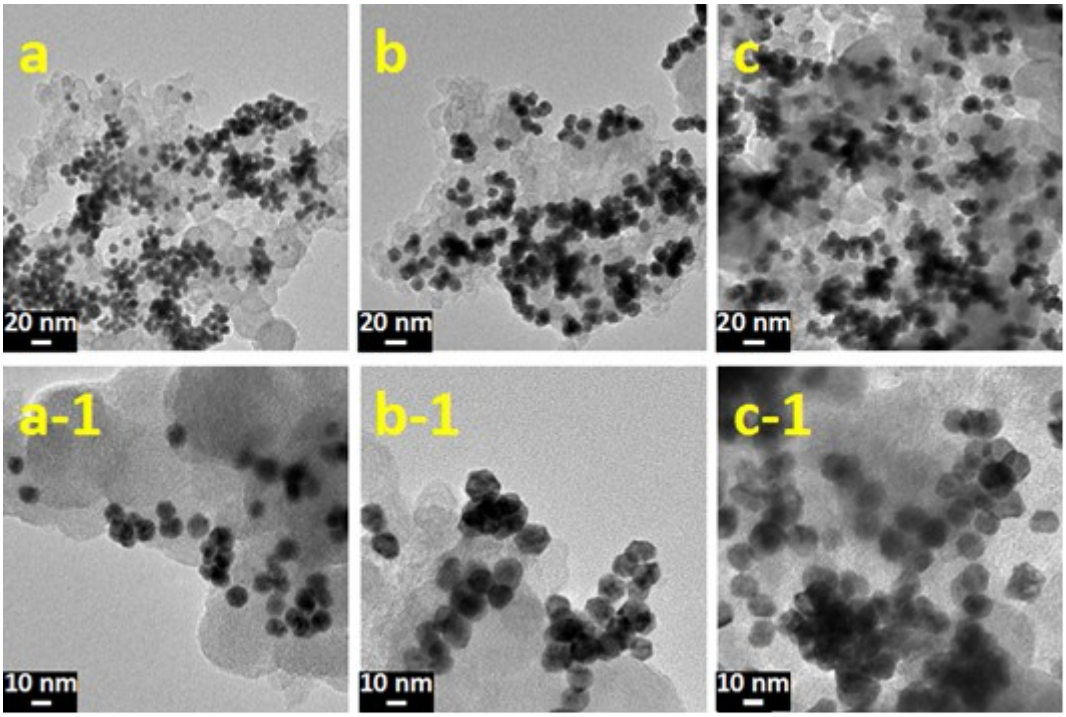

Figure S6. TEM images of Au-7.7@Ni_mPt_m/C samples: (a) ***m***=1, (b) ***m***=4, (c) ***m***=6.

1. XRD characterizations

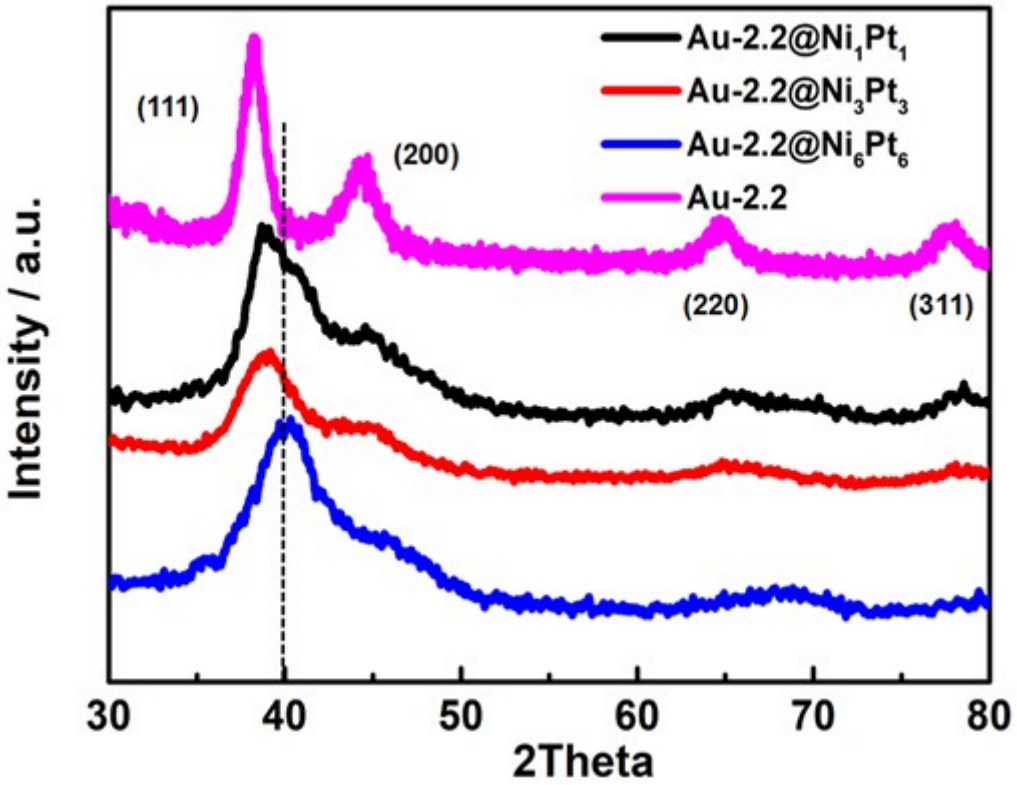

Figure S7. XRD patterns for Au-2.2@Ni_1Pt_1/C, Au-2.2@Ni_3Pt_3/C, Au-2.2@Ni_6Pt_6/C, Au-2.2/C and PtNi/C.

2. Activity of Au-7.7@Ni_mPt_m/C samples

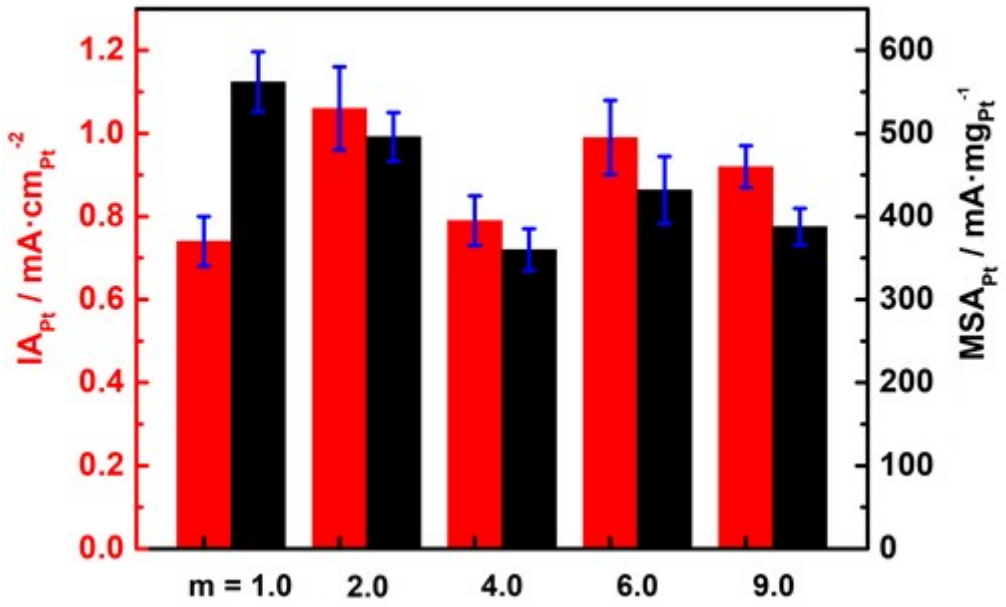

Figure S8. (a) MSA_{Pt} and IA_{Pt} data of Au-7.7@Ni_mPt_m/C samples (***m***=1, 2, 4, 6, 9) at 0.9 V.

3. Detailed information for Au-*d*@Ni_mPt_m/C samples

Table S1. Electrochemical properties of the Au-*d*@Ni_mPt_m/C samples.

Sample	EAS_{Pt} ($m^2 \cdot g_{Pt}^{-1}$)	Half-wave Potentials (V)	IA_{Pt} ($mA \cdot cm_{Pt}^{-2}$)	MSA_{Pt} ($mA \cdot mg_{Pt}^{-1}$)
Au-2.2@$Ni_{0.5}Pt_{0.5}$	102 (58)*	0.86	0.15 (0.1)*	157 (59)*
Au-2.2@Ni_1Pt_1	86	0.91	0.37	328
Au-2.2@Ni_2Pt_2	83	0.92	0.51	423
Au-2.2@$Ni_{2.5}Pt_{2.5}$	81	0.92	0.42	346
Au-2.2@Ni_3Pt_3	78 (48)*	0.91	0.43 (0.31)*	330 (153)*
Au-2.2@Ni_6Pt_6	57 (40)*	0.91	0.48 (0.45)*	278 (184)*
Au-3.3@Ni_2Pt_2	71	0.91	0.56	402
Au-4.5@Ni_2Pt_2	61	0.91	0.60	363
Au-7.7@Ni_2Pt_2	47 (33)*	0.93	1.06 (0.98)*	496 (322)*
Au-7.7@Ni_1Pt_1	76	0.93	0.74	562
Au-7.7@Ni_4Pt_4	45	0.93	0.79	360
Au-7.7@Ni_6Pt_6	44	0.94	0.99	432
Au-7.7@Ni_9Pt_9	42	0.93	0.92	388
Au-10.3@ Ni_2Pt_2	36	0.92	1.09	392
Pt/C (E-TEK)	76 (32)*	0.88	0.25 (0.17)*	189 (66)*
PtNi/C	39 (35)*	0.92	1.01 (0.37)*	389 (135)*

* The numbers in the parentheses were obtained in the measurements after ADT.

Table S2. Detailed experimental parameters/conditions for the synthesis of Au NPs of different sizes

Sample	d_{seeds} (nm)[a]	V_{seeds} (ml)[b]	V_{HAuCl4} (ml)[c]	V_{AA} (ml)[d]	D (nm)[e]
Au-2.2	-	-	1.00	-	2.2 ± 0.3
Au-3.3	2.2	10.0	0.25	3.8	3.3 ± 0.5
Au-4.5	2.2	10.0	1.00	15.0	4.5 ± 0.7
Au-7.7	4.7	8.2	0.50	7.5	7.7 ± 1.2
Au-10.3	4.7	5.8	1.00	15.0	10.3 ± 1.9

[a] Average size by diameter of Au seeds. [b] The concentration of Au was 1.0×10^{-3} M. [c] The concentration of $HAuCl_4$ was 5.0×10^{-3} M. [d] The concentration of ascorbic acid was 5.0×10^{-3} M. [e] Average size by diameter of Au NPs.