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

Figure S1

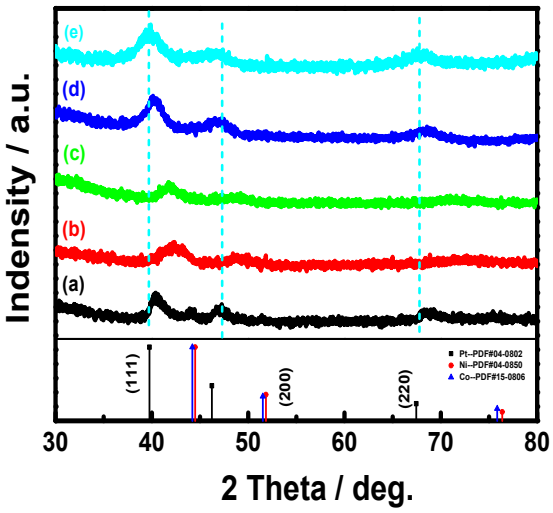

Fig.S1 XRD patterns of the PtNiCo samples. (a) NCs, (b) CHs, (c) CTs, (d) NPs, and (e) NSs.

Figure S2

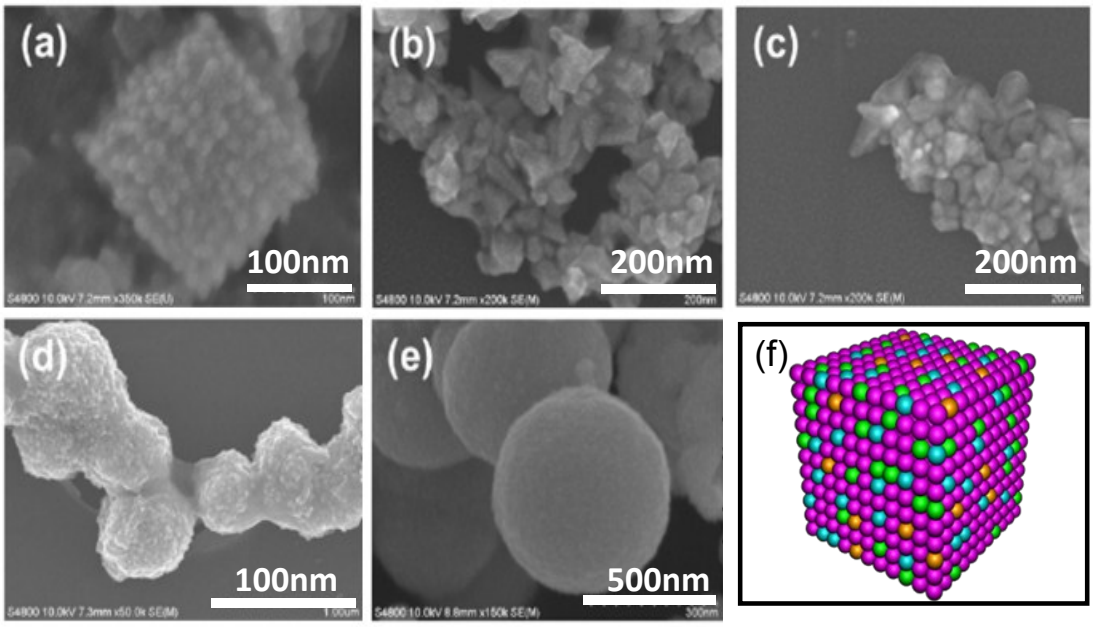

Fig.S2 SEM images of PtNiCo catalysts. (a) NCs, (b) CHs, (c) CTs, (d) NPs, (e) NSs, and (f) geometric model of individual NCs structure.

Figure S3

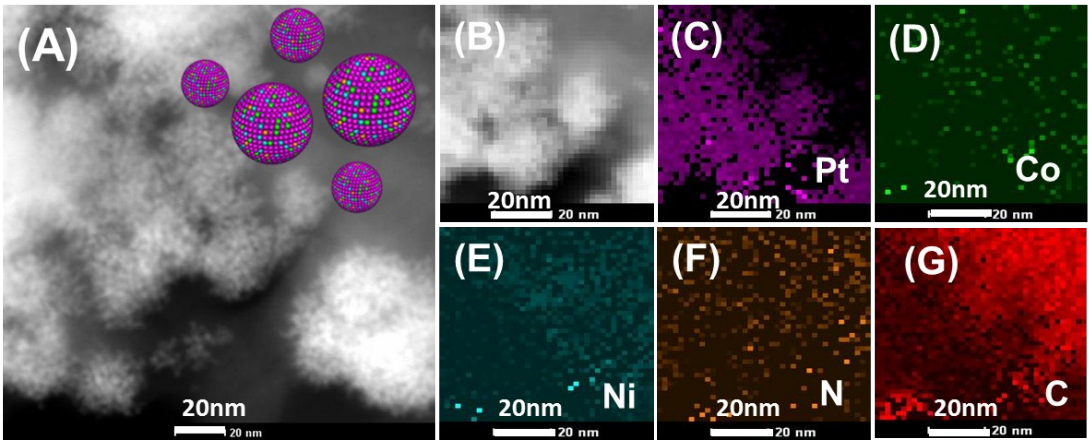

Fig.S3 HAADF-STEM images and the corresponding mapping results of Pt, Ni, Co, C and N for NPs sample (A)-(G).

Figure S4

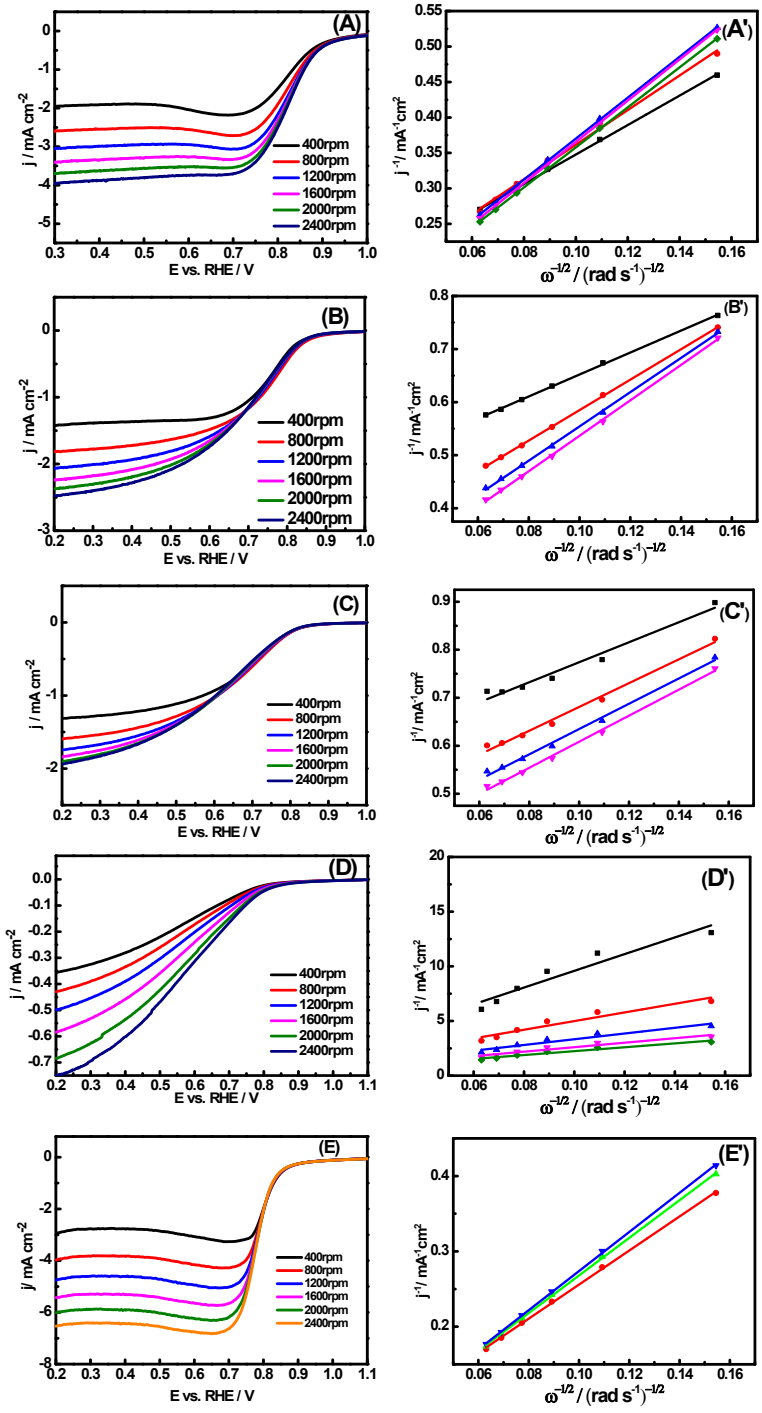

Fig.S4 ORR polarization curves at different ratation rates and K-L plots of the ORR for (A) CHs, (B) CTs, (C) NPs, (D) NSs and (E) the commercial Pt/C catalysts.

Figure S5

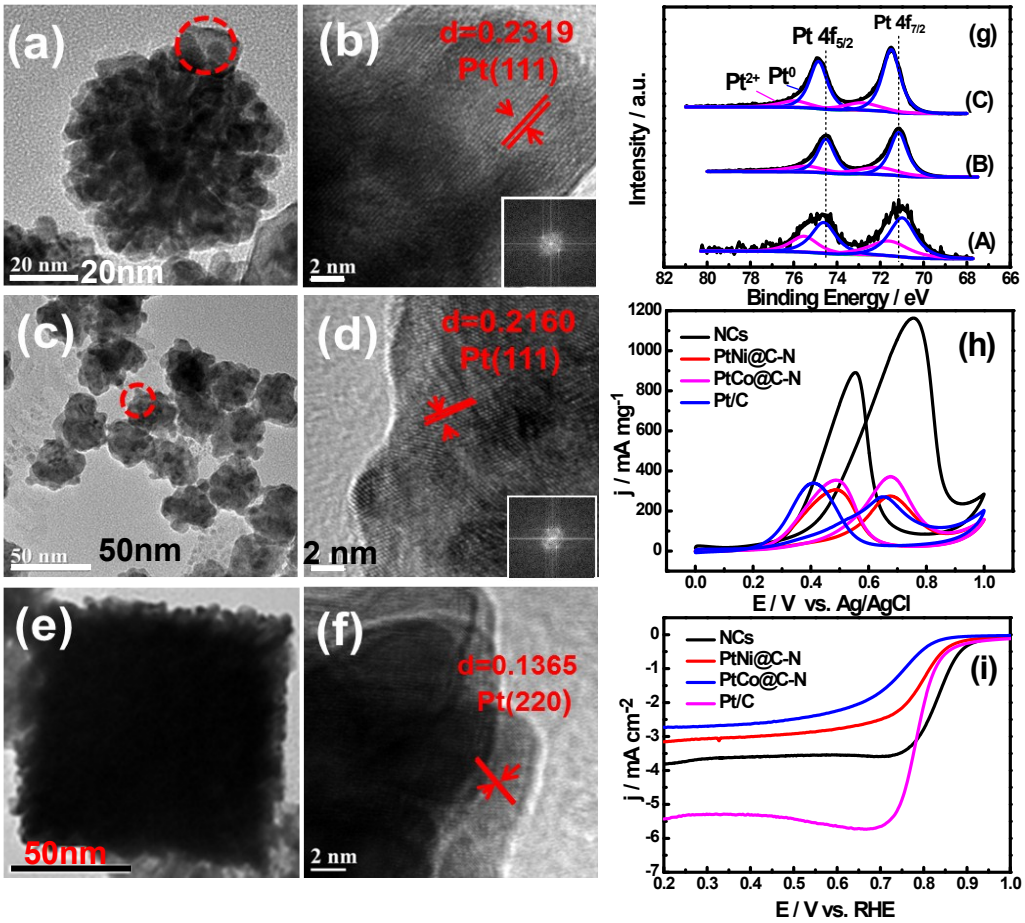

Fig.S5 HRTEM images of (a, b) PtNi@C-N, (c, d) PtCo@C-N, (e, f) NCs catalysts. (g) XPS of Pt 4f for PtNi@C-N (A), PtCo@C-N (B), NCs (C) catalysts. (h) MOR and (i) ORR property of PtNi@C-N, PtCo@C-N, NCs, and the commercial Pt/C catalysts.

Table S1. ECSA for PtNiCo samples and the Pt/C catalysts in N_2-saturated 0.5 M H_2SO_4 at a scan rate of 100 mV s^{-1}. Mass and Specific activity for PtNiCo samples and the Pt/C catalysts in 0.5 M H_2SO_4 + 1.0 M CH_3OH at a scan rate of 50 mV s^{-1}.

Samples	ECSA/$m^2 \cdot g^{-1}_{Pt}$	MA/mA mg^{-1}	SA/mA cm^{-2}
NCs	72.4	1165	1.6
CHs	64.4	898.3	1.4
CTs	43.4	598．1	1.37
NPs	22.5	84.1	0.37
NSs	10.4	71.7	0.7
Pt/C	37.0	271.1	0.73

Table S2. Peak potential, onset potential of CO oxidation and ECSA for PtNiCo samples and the Pt/C catalyst in CO-stripping voltammograms which obtained in CO-saturated 0.1 M $HClO_4$ at a scan rate of 50 mV·s^{-1}.

Sample	Peak potential of CO oxidation (V)	Onset potential of CO oxidation (V)	ECSA/$m^2 \cdot g^{-1}_{Pt}$
NCs	0.80	0.45	35.8
CHs	0.75	0.66	34.9
CTs	0.75	0.66	35.8
NPs	0.86	0.76	7.0
NSs	0.94	0.81	0.54
Pt/C	0.94	0.86	34.1

Table S3. The number of transferred electrons (n) value for these nanocomposites.

Sample	0.7 V	0.6 V	0.5 V	0.4 V	0.3 V	n
NCs	4.0	3.4	3.10	3.1	3.2	3.4
CHs	4.3	3.7	3.2	3.1	3.2	3.6
CTs	–	4.3	3.2	2.80	2.7	3.3
NPs	–	–	4.3	3.6	3.5	3.8
Pt/C	4.5	3.9	3.6	3.5	3.5	3.8

Table S4. The measured current density j, the kinetics-limited current density j_k, and the electron transfer number (n) values for these nanocomposites.

Sample	j	j_k	B	n
NCs	3.59	15.94	0.37	3.4
CHs	3.33	10.88	0.39	3.6
CTs	1.96	3.71	0.36	3.3
NPs	1.64	2.43	0.41	3.8
Pt/C	5.32	53.26	0.41	3.8