Supporting Information

A facile strategy for branched Pt-Pd-M (M=Co, Ni) trimetallic nanocrystals

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Chemicals: Reagents including $Co(NO_3)_2 \cdot 6H_2O$, $Ni(NO_3)_2 \cdot 6H_2O$, octadecylamine (ODA), $H_2PtCl_6 \cdot 6H_2O$, ethanol, and cyclohexane, were of analytical grade from the Beijing Chemical Factory. Platinum pentanedionate ($Pt(acac)_2$), $Pd(acac)_2$, $PdCl_2$ and Nafion solution were purchased from Alfa Aecar. All the chemicals were used as received without further purification.

Characterization: The powder X-ray diffraction patterns were recorded with a Bruker D8-advance X-ray powder diffractometer with Cu Kα radiation (λ = 1.5406 Å).The size and morphology of as-synthesized samples were determined by using Hitachi model H-800 transmission electron microscope and JEOL-2010F high-resolution transmission electron microscope. Energy dispersive spectroscopy was recorded to determine the composition of the products. Electrochemical measurements were conducted on CHI 660Dat room temperature.

Synthesis: In a typical synthesis of branched Pt-Pd-Co nancrystals, A mixture of 13 mg $H_2PtCl_6 \cdot 6H_2O$, 15 mg $PdCl_2$, and 16 mg $Co(NO_3)_2 \cdot 6H_2O$ were added into 0.5 g ODA at 120 ^oC to form a clear solution in a vial labeled as A. 2 g ODA was loaded in a 25 mL two-neck flask and heated to 240 ^oC. The solution in the vial A was then added into the flask. The reaction mixture was aged at 240 ^oC for 10 min. The products were collected and then washed with ethanol for several times. Similarly, by adding $Ni(NO_3)_2 \cdot 6H_2O$ instead of $Co(NO_3)_2 \cdot 6H_2O$, branched Pt-Pd-Ni nanocrystals can be made.

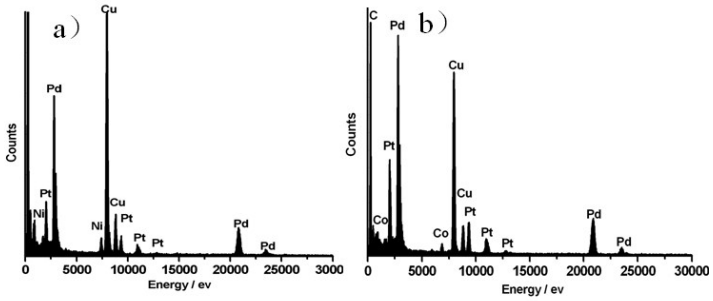

Figure S1. EDX patterns of a) Pt-Pd-Ni and b) Pt-Pd-Co NCs.

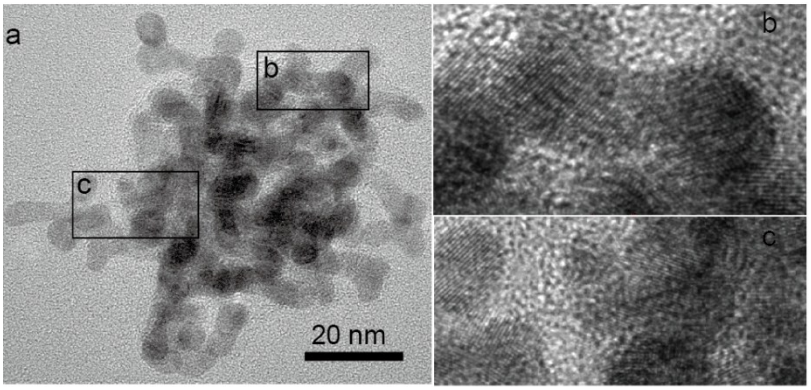

Figure S2. a) TEM image of one Pt-Pd-Co nanocrystals; b–c) HRTEM images of Pt-Pd-Co nanocrystals as selected by the black square frames.

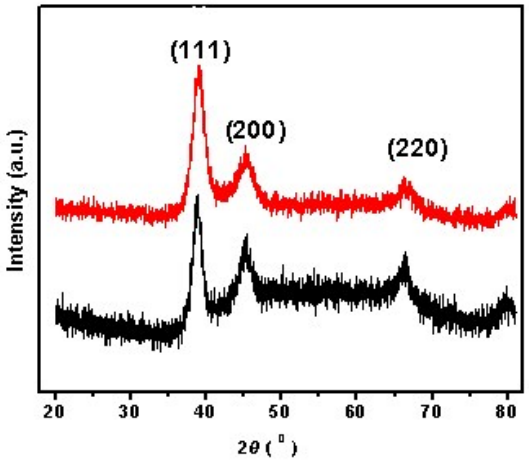

Figure S3. XRD patterns of Pt-Pd-Ni (red line), and Pt-Pd-Co (black line) nanostructures.

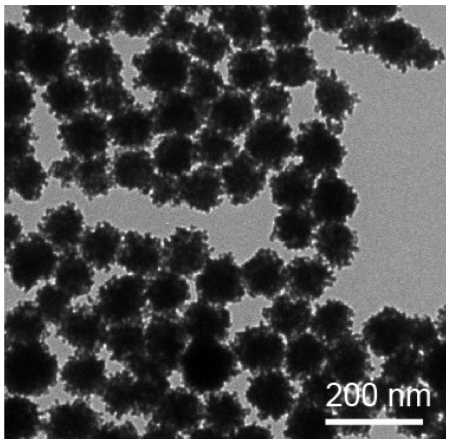

Figure S4.TEM images of Pt-Pd-Co NCs obtained at 15 min.

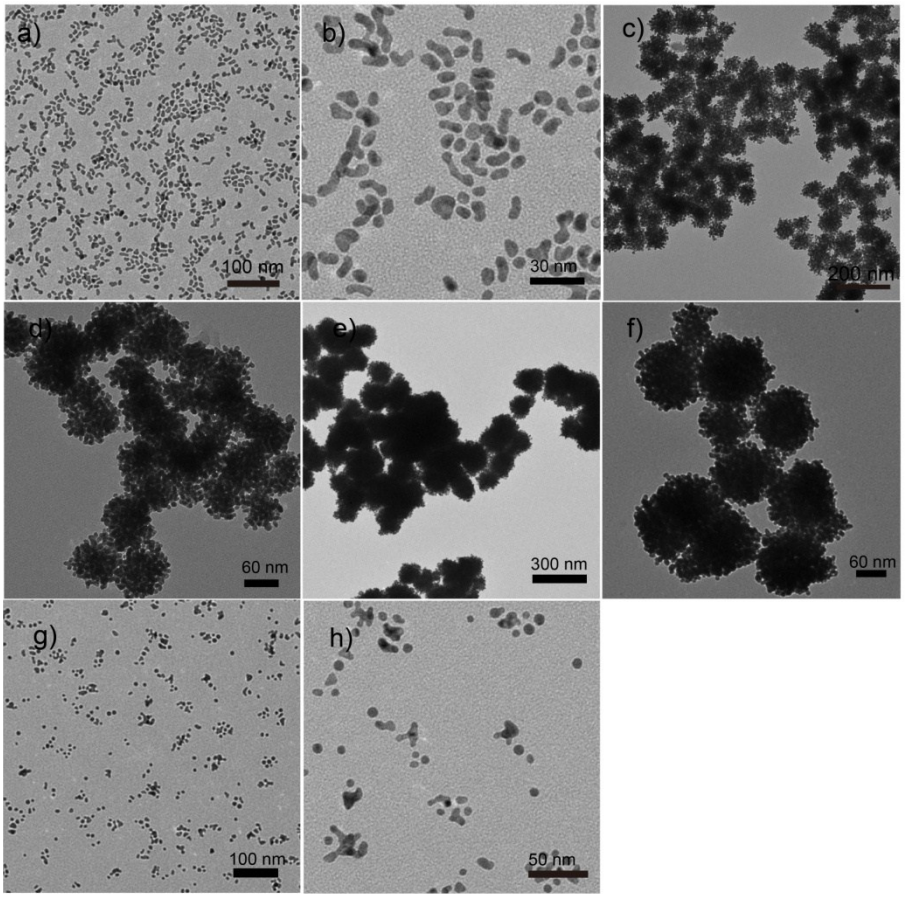

Figure S5. TEM images of the products obtained from the reaction with the identical condition but (a, b) changing $H_2PtCl_6 \cdot 6H_2O$ into $Pt(acac)_2$, (c, d) changing $PdCl_2$ into $Pd(acac)_2$, (e, f) changing $Co(NO_3)_2 \cdot 6H_2O$ into $Co(acac)_2$ and (g, h) changing all the precursor into their corresponding acetylacetone salt.

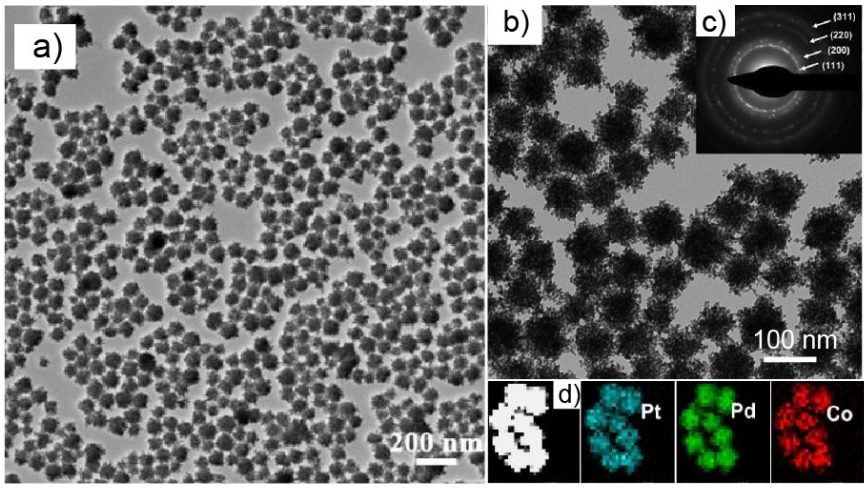

Figure S6. (a) low-magnification TEM, (b) high-magnification TEM (right-top inset shows corresponding SAED pattern), (c) HAADF-STEM images, and EDS mapping of trimetallic Pt-Pd-Co nanodendrites.

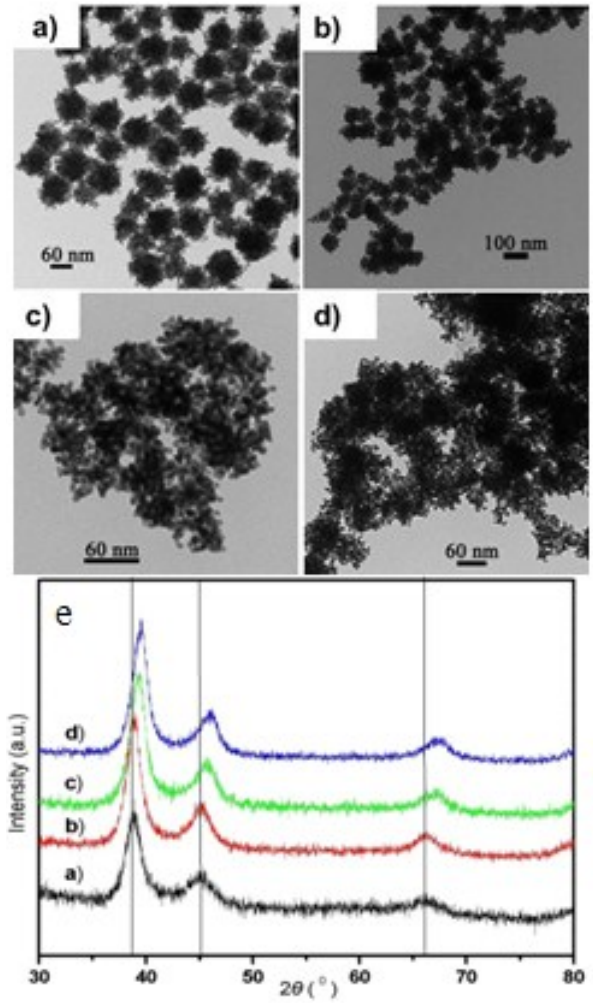

Figure S7. TEM images of Pt-Pd-Co nanocrystals obtained at different reaction temperature: (a) 220 °C, (b) 240 °C, (c) 260 °C, (d) 280 °C, and (e) XRD patterns of Pt-Pd-Co nanocrystals with different reaction temperature.

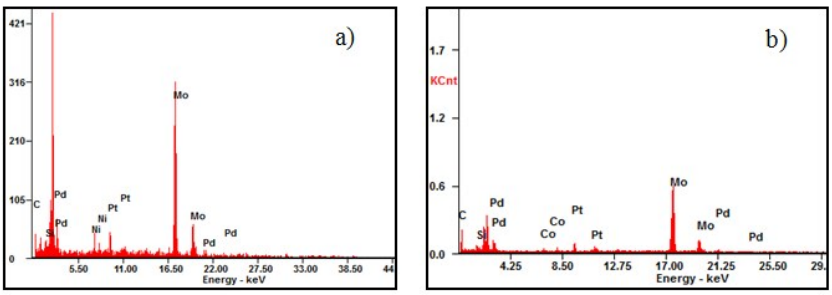

Figure S8. EDX patterns of a) Pt-Pd-Ni NCs, the Pt:Pd:Ni atomic ratios were 0.35:0.44:0.21; b) Pt-Pd-Co NCs, the Pt:Pd:Co atomic ratios were 0.40:0.45:0.15.