Balancing the galvanic replacement and reduction kinetics for the general formation of bimetallic CuM (M = Ru, Rh, Pd, Os, Ir, Pt) hollow nanostructures

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**Fig. S1** TEM image (a) and HRTEM images (b) of the Cu nanoparticles synthesized in oleylamine at 180°C, which are used as seeds for the formation of bimetallic hollow nanostructures in a galvanic replacement reaction at appropriate temperatures.

**Fig. S2** Elemental mapping of a single particle (a–d) of the bimetallic Cu-Pt hollow nanostructures synthesized in oleylamine at a temperature of 160°C.
Fig. S3 EDX-based element profiles of bimetallic CuPt nanoparticles as-prepared by reacting Pt$^{4+}$ ions with the Cu seeds in oleylamine at temperature of 220°C.

Fig. S4 TEM image (a), HRTEM image (b), and EDX-based element profiles (c) of bimetallic CuPt nanoparticles as-prepared by reacting Pt$^{4+}$ ions with the Cu seeds in oleylamine at temperature of 250°C.
**Fig. S5** TEM images (a₁), elemental mappings (a₂—a₅), and STEM-EDX analyses (a₆) of binary CuOs nanostructures synthesized by GRR between Cu seeds and Os ion precursors in oleylamine at temperature of 245°C. Inserts in (a₁) is HRTEM images of the a single CuOs nanostructure.

**Fig. S6** TEM images carbon-supported hCuPtNSs prepared at temperature of 120°C (a) and 160°C (b) in oleylamine.
**Fig. S7** Cyclic voltammograms of hCuPtNSs-120/C, hCuPtNSs-160/C, and E-TEK Pt/C catalysts in argon-purged HClO₄ (0.1 M) at room temperature obtained with scan rate of 50 mV s⁻¹.

**Fig. S8** TEM images of as-prepared hCuRuNSs (a) and hCuO-RuO₂/CNT (b) supported on the surface of carbon nanotube substrates.