Electronic Supplementary Material (ESI) for Nanoscale.

Electronic Supplementary Information

Enhanced catalytic activity for CO oxidation by the metal–oxide perimeter of TiO_2/nanostructured Au inverse catalysts

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1. Anodization and reduction conditions for fabrication of nanoporous Au and nanorod Au.

Figure S1 shows the reduced anodic (RA) treatment including two sequential processes: anodization to form Au oxide and reduction for anodized Au by applying a constant applied potential and current density. The RA treatment with an anodic potential of 2.3 V and reduction current of −3.0 mA cm^{-2} forms nanoporous Au. Meanwhile, nanorod Au is obtained via anodization under 2.5 V and reduction at −6.0 mA cm^{-2}.

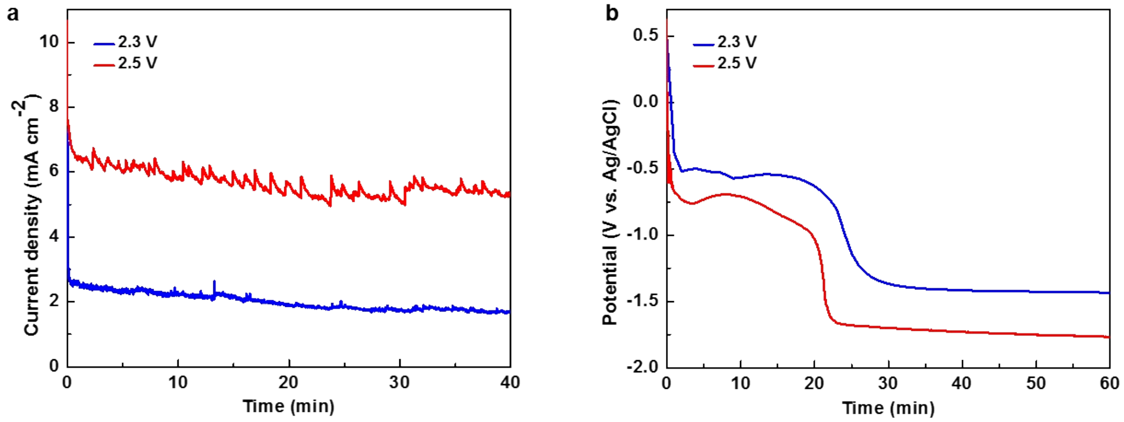

Figure S1. Electrochemical synthesis process of Au nanostructures consisting of anodization and reduction in a 0.2 M $KHCO_3$ solution. (a) Time-dependent current density plots for the Au anodizing step at applied potentials of 2.3 and 2.5 V (vs. RHE) and (b) potential variation during the reduction of the oxidized Au under constant current densities of −3.0 and −6.0 mA cm^{-2} for the Au anodized at 2.3 and 2.5 V, respectively.

2. Top-view SEM images of as-prepared nanoporous Au and nanorod Au and size distribution histograms for nanorod Au.

Figure S2 shows top-view SEM images of the nanoporous Au and nanorod Au and the size distribution of the diameter for the nanorod Au. As shown in the histogram, the average diameter for the nanorod Au was 81 ± 17 nm.

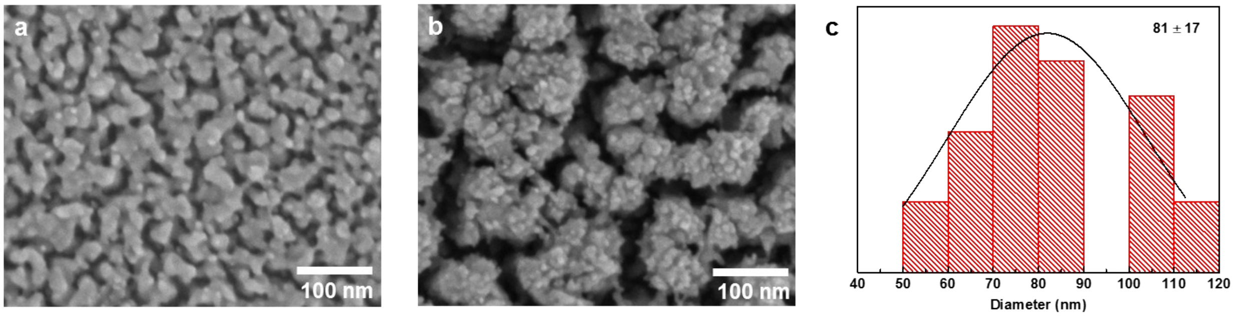

Figure S2. Top-view SEM images of (a) nanoporous Au and (b) nanorod Au. (c) Diameter size distribution histogram for nanorod Au.

3. X-ray photoelectron spectroscopy (XPS) spectra of the TiO_2/nanoporous Au and TiO_2/nanorod Au catalysts.

Figure S3 shows the chemical state of the gold (Au 4f) and titanium dioxide (Ti 2p and O 1s) taken on the 0.5 wt% TiO_2/nanoporous Au and 0.5 wt% TiO_2/nanorod Au catalyst using X-ray photoelectron spectroscopy (XPS, Thermo VG Scientific Sigma Probe system with an Al Kα X-ray source (1486.3 eV)). All the binding energies were calibrated to the C 1s peak at 284.8 eV. After TTIP immersion and annealing in an oven, the nanoporous Au and nanorod Au were maintained in their metallic state (84.0 eV), and formation of titanium dioxide can be confirmed from the peak binding energy (458.5 eV) in the Ti 2p spectra and the O–Ti^{4+} peak (530.5 eV) in the O 1s spectra. The peak positions of all the components were almost identical for both the TiO_2/nanoporous Au and TiO_2/nanorod Au, representing that the electric structures of both nanostructures were almost the same.

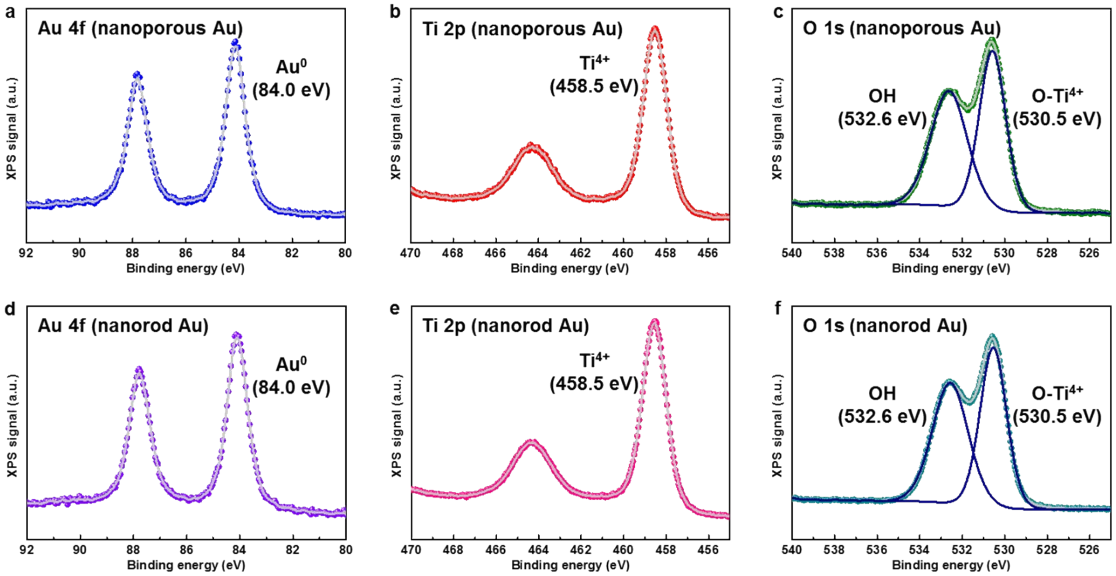

Figure S3. XPS spectra of (a), (d) Au 4f, (b), (e) Ti 2p, and (c), (f) O 1s of the 0.5 wt% TiO_2/nanoporous Au and 0.5 wt% TiO_2/nanorod Au catalysts.

4. Cross-sectional HR-TEM image of the 1.0 wt% TiO_2/nanoporous Au.

Figure S4 shows a cross-sectional HR-TEM image of the 1.0 wt% TiO_2/nanoporous Au indicating that an interface between the TiO_2 and Au was not formed because of the high surface coverage of TiO_2 on Au.

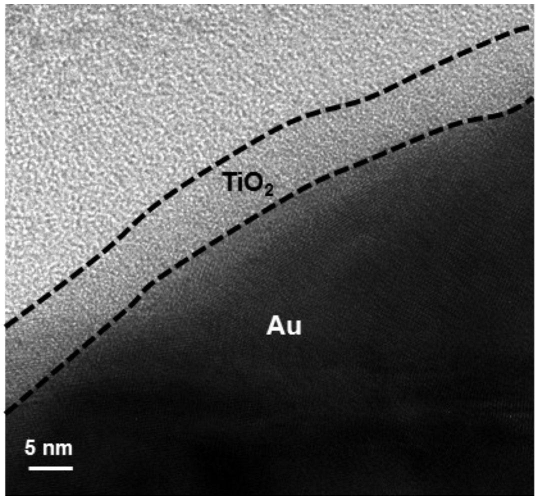

Figure S4. A cross-sectional HR-TEM image of the 1.0 wt% TiO_2/nanoporous Au.