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

Supplementary Information

Direct Propanol Synthesis from CO_2, C_2H_4, and H_2 over Cs-Au/TiO_2 Rutile: Effect of Promoter Loading, Temperature and Feed Composition

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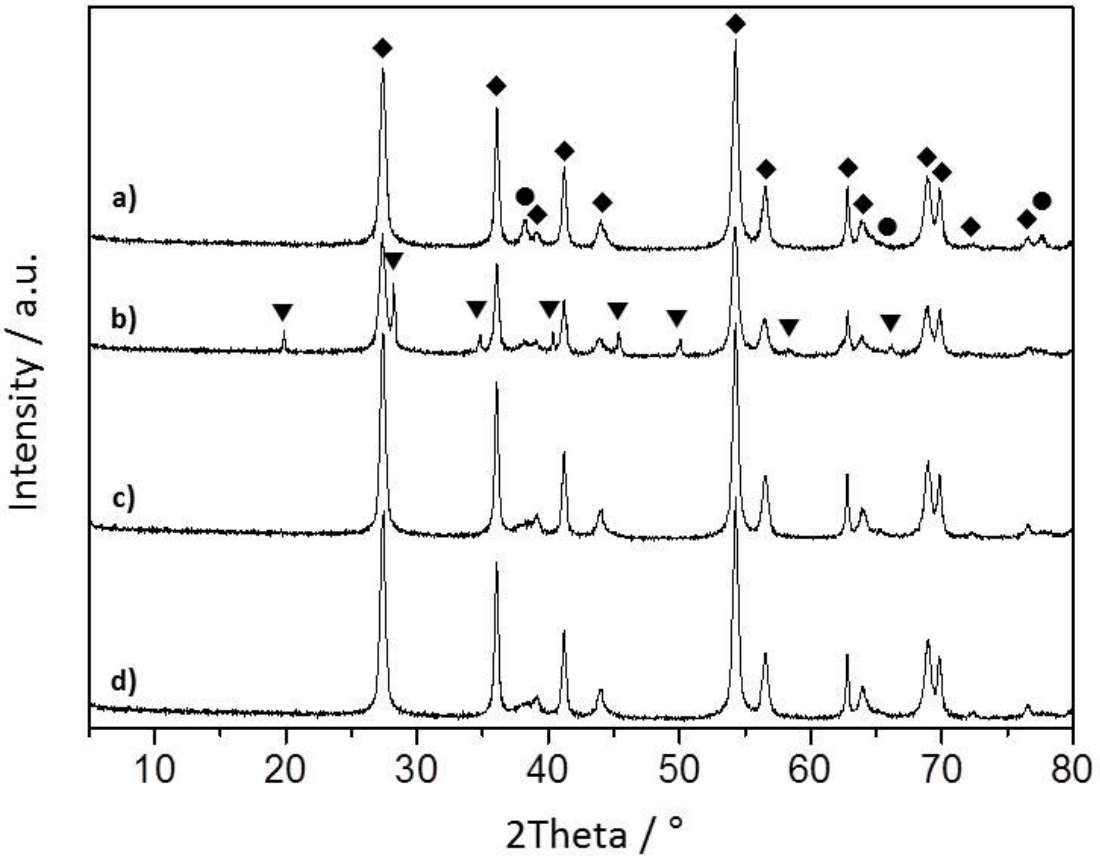

Fig. S1 XRD analysis of fresh (a) 1Cs-Au/TiO_2 and (b) 10Cs-Au/TiO_2 as well as used (c) 1Cs-Au/TiO_2 and (d) 10Cs-Au/TiO_2. ◆ = TiO_2 rutile, ● = Au, ▼ = $CsNO_3$.

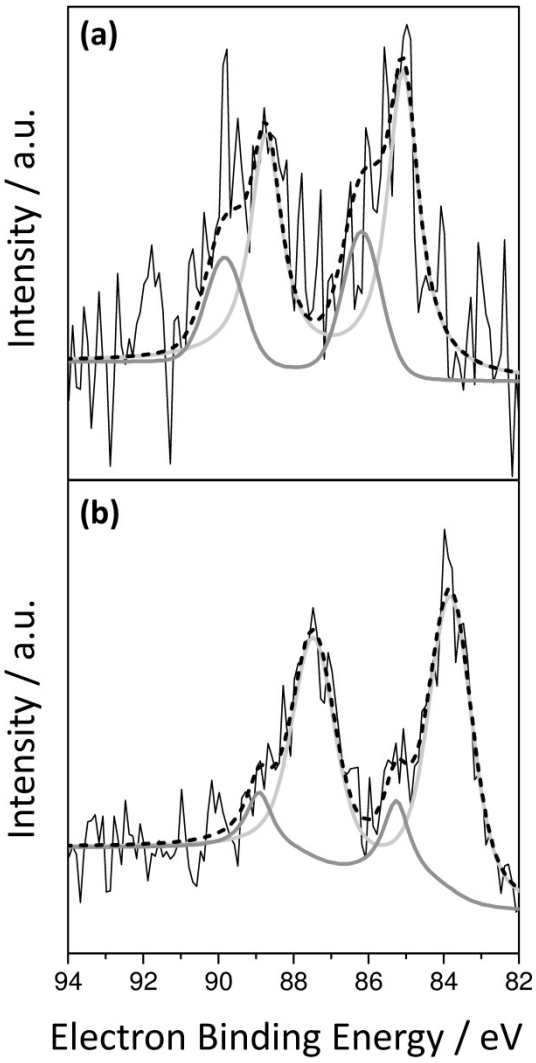

Fig. S2 Au 4f XP spectra of used (a) 1Cs-Au/TiO_2 and (b) 10Cs-Au/TiO_2. The dashed line is fitted to the original signal while the light grey and grey ones correspond to Au^0 and $Au^{\delta+}$ respectively.

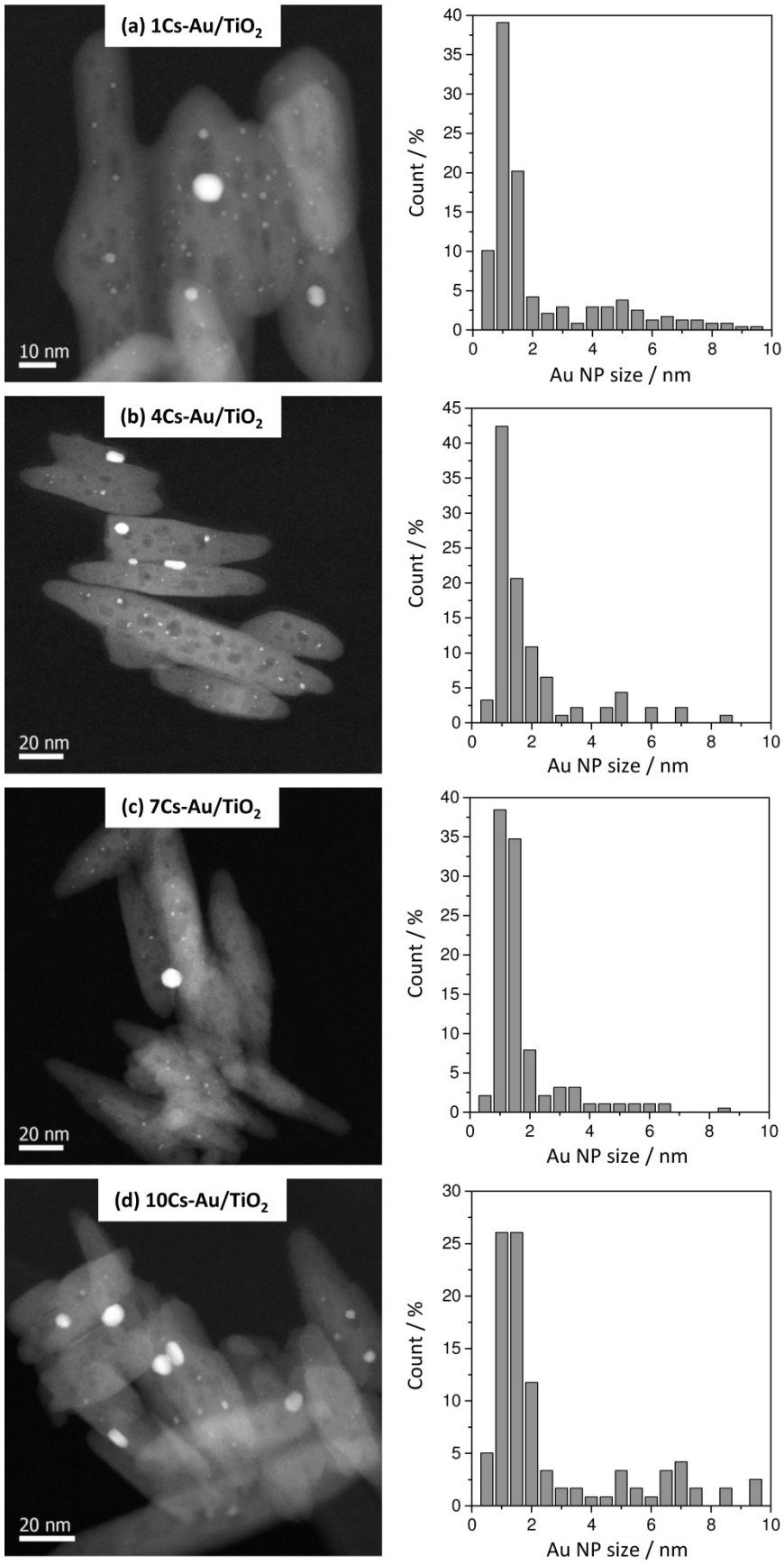

Fig. S3 HAADF-STEM images of (a) 1Cs-Au/TiO_2, (b) 4Cs-Au/TiO_2, (c) 7Cs-Au/TiO_2, and (d) 10Cs-Au/TiO_2 as well as their corresponding histograms.

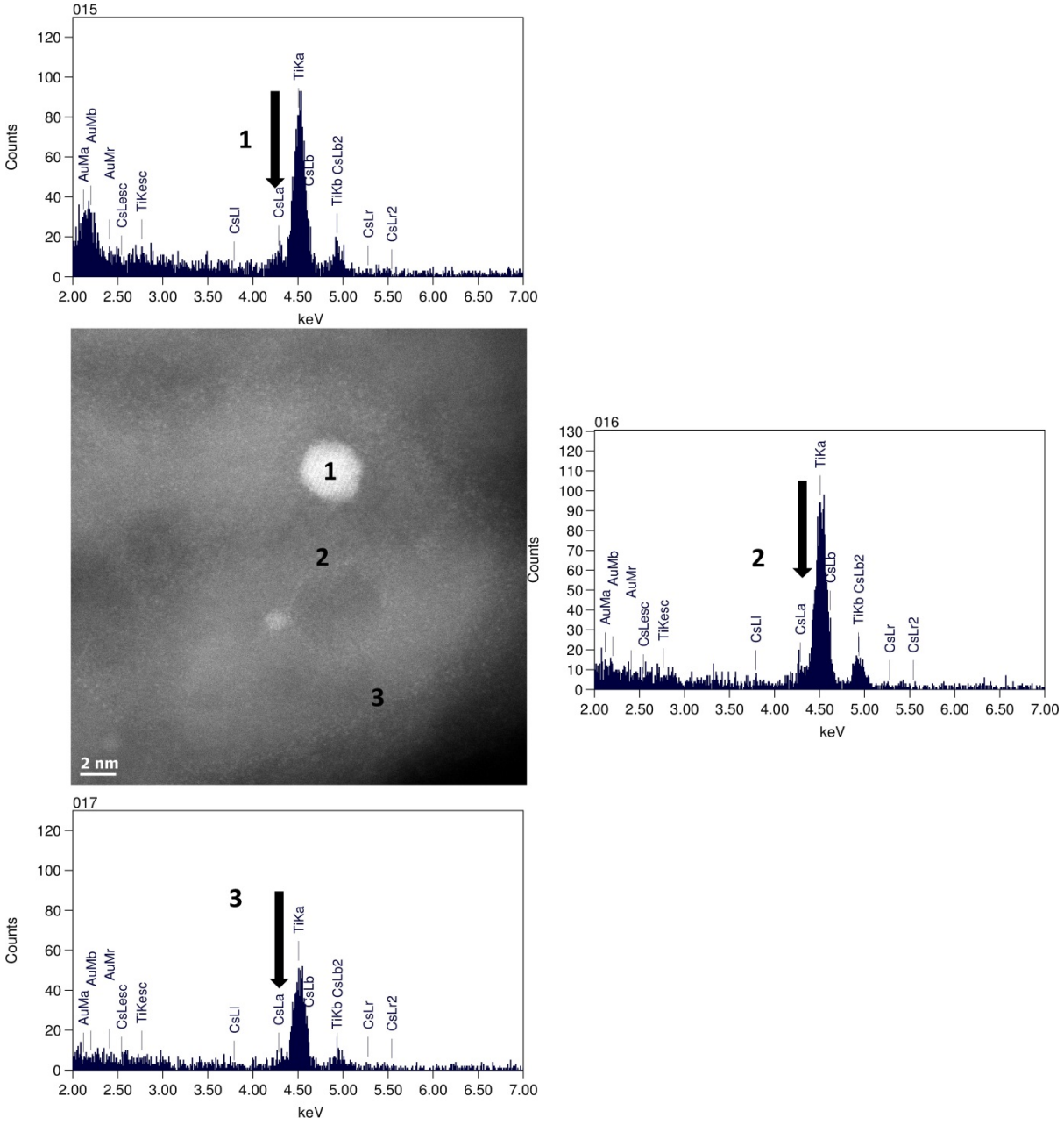

Fig. S4 EDX analysis of 10Cs-Au/TiO_2 showing Cs on/near the Au NP (1) and on the edges of the dips (2). However, it is hardly detectable at the plain TiO_2 surface (3) due to overlapping of both signals.

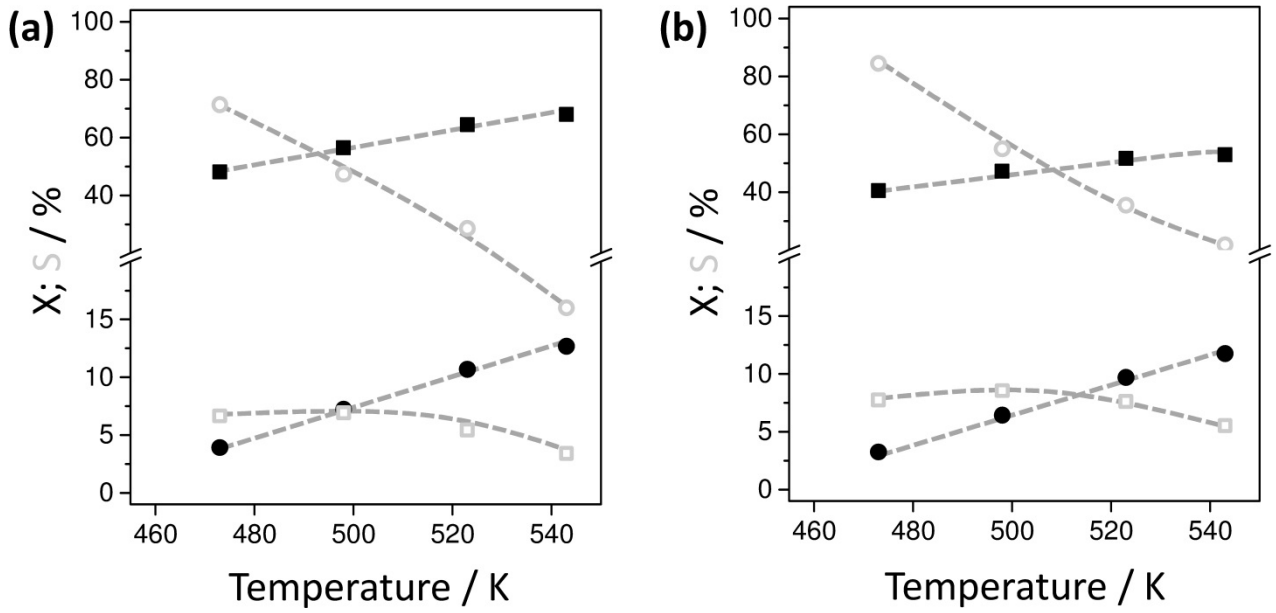

Fig. S5 Conversion of CO_2 (●) and C_2H_4 (■) and the selectivity to propanol based on CO_2 (○) and C_2H_4 (□) upon (a) 4Cs-Au/TiO_2 and (b) 7Cs-Au/TiO_2 as a function of the temperature. Reaction conditions: $CO_2/H_2/C_2H_4/N_2$ = 1:2:1:4, 2 MPa, contact time of 45 g min l^{-1}.

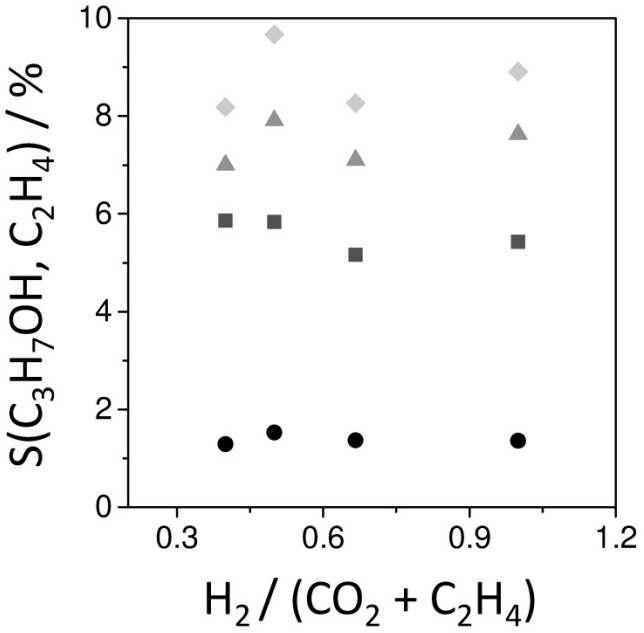

Fig. S6 Effect of the $H_2/(CO_2+C_2H_4)$ ratio on the selectivity to propanol based on C_2H_4 upon 1Cs-Au/TiO_2 (●), 4Cs-Au/TiO_2 (■), 7Cs-Au/TiO_2 (▲), and 10Cs-Au/TiO_2 (◆). Reaction conditions: 523 K, 2 MPa, contact time of 45 g min l^{-1}.

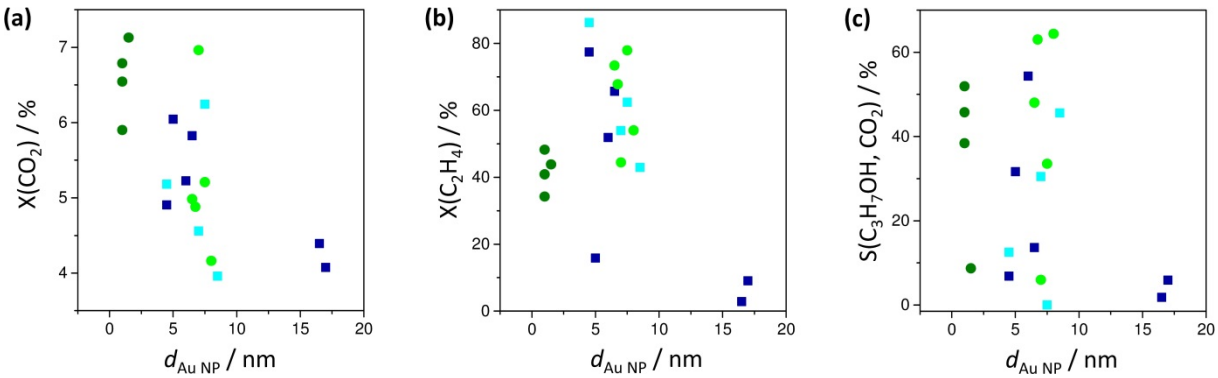

Fig. S7 Conversion of (a) CO_2 and (b) C_2H_4 and (c) the selectivity to propanol based on CO_2 against Au particle size in Cs-Au/TiO_2 rutile (●), Cs-Au/TiO_2 anatase (■), K-Au/TiO_2 rutile (●), and K-Au/TiO_2 anatase (■) catalysts. Reaction conditions: $CO_2/H_2/C_2H_4/N_2$ = 1:1:1:1, 523 K, 2 MPa, contact time of 45 g min l^{-1}.