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Supplementary on-line information

Continuous flow synthesis of bimetallic AuPd catalysts for the selective oxidation of 5-hydroxymethylfurfural to 2,4-furandicarboxylic acid

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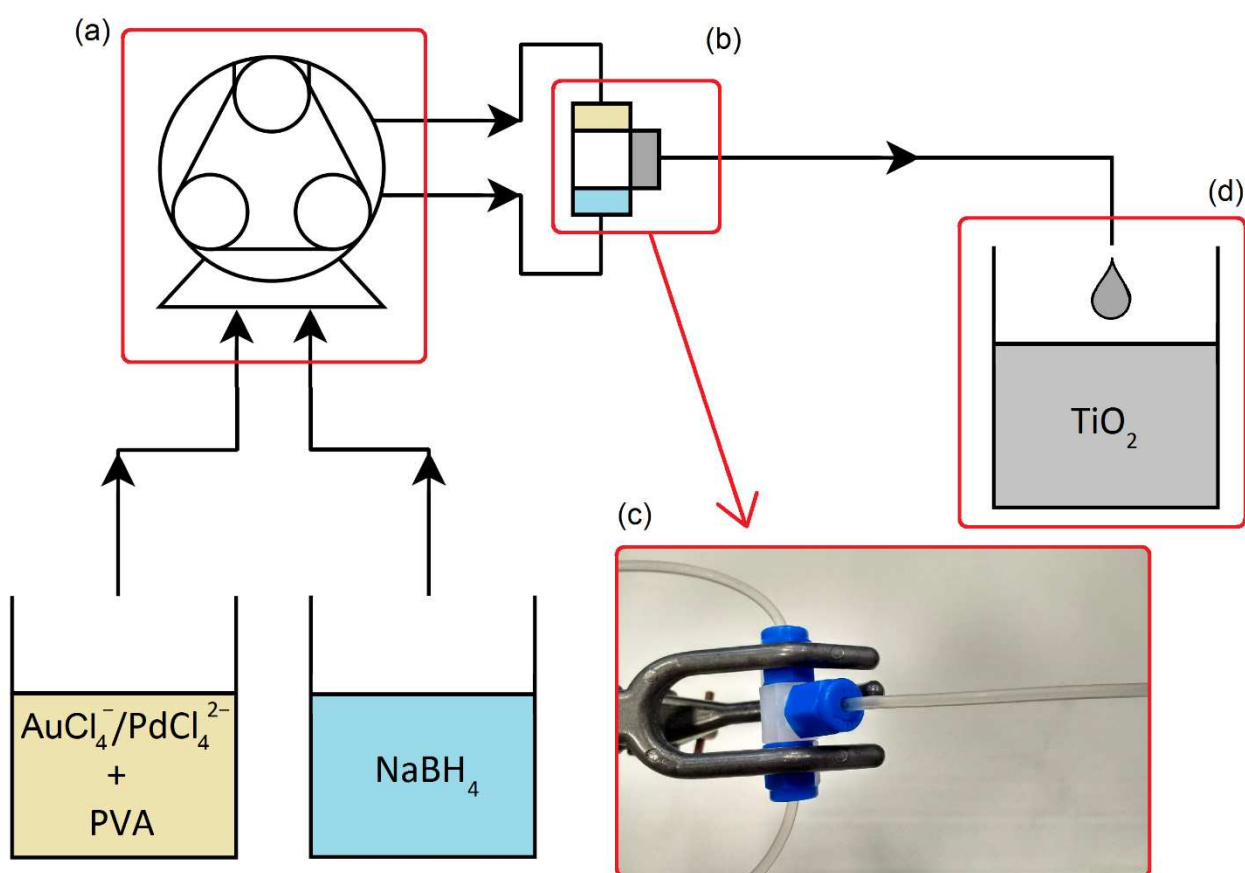


Figure S1: Schematic representation of the millifluidic set-up for the synthesis of Au_xPd_y/TiO_2 catalysts in continuous mode. (a) Peristaltic pump, (b) PFA T-shape connection, (c) image of the PFA T-shape connection and (d) suspension of TiO_2 in water.

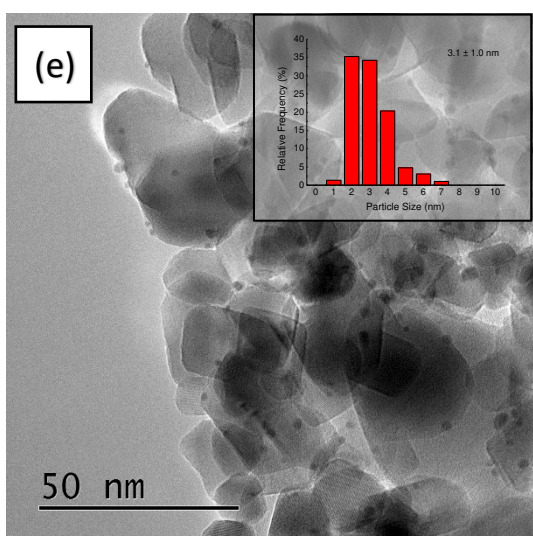
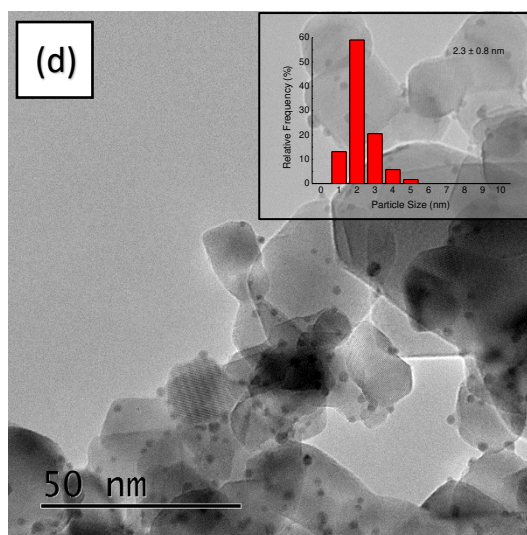
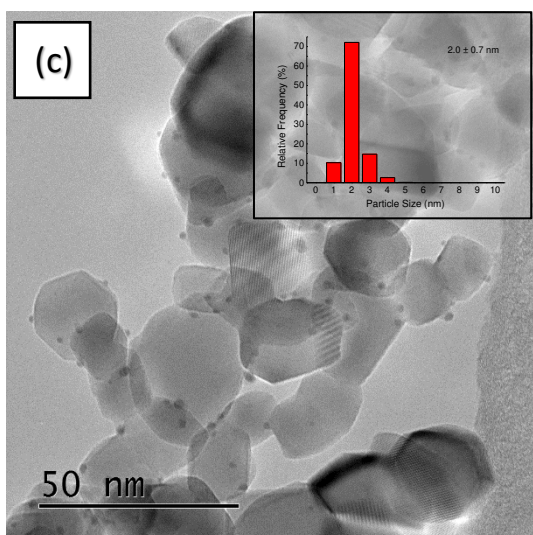
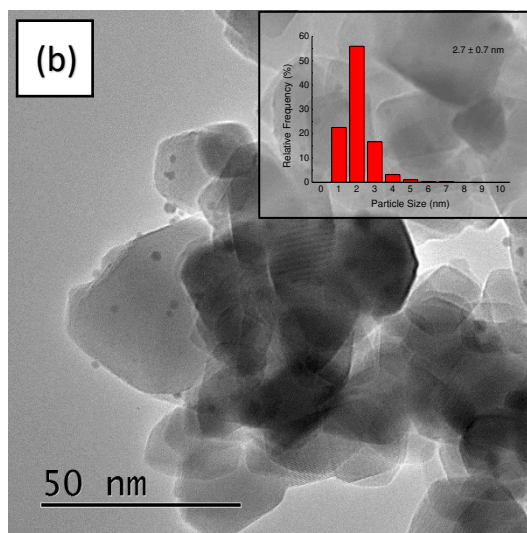
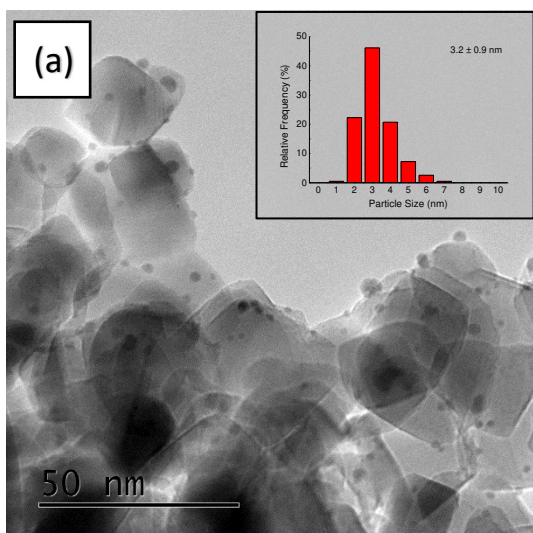


Figure S2: Representative BF-TEM images and (inset) respective particle size distributions of the various catalysts prepared in continuous mode: (a) Au/TiO₂, (b) Au₇₅Pd₂₅/TiO₂, (c) Au₅₀Pd₅₀/TiO₂, (d) Au₂₅Pd₇₅/TiO₂ and (e) Pd/TiO₂.

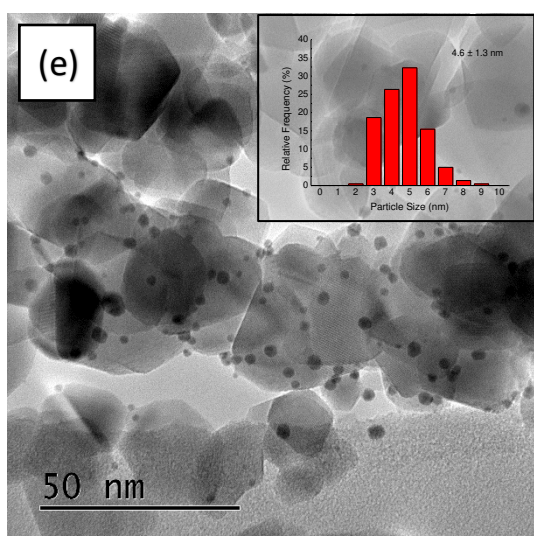
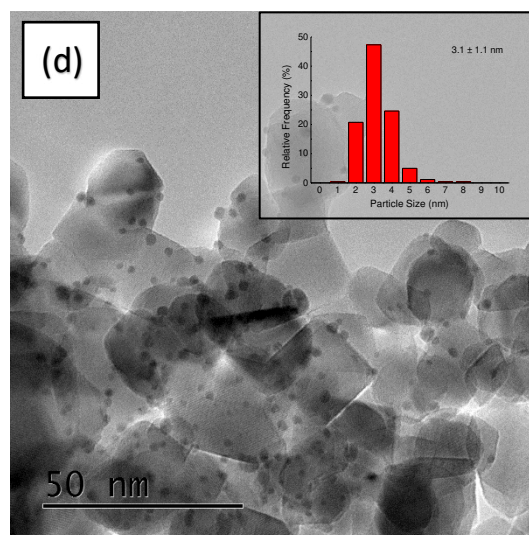
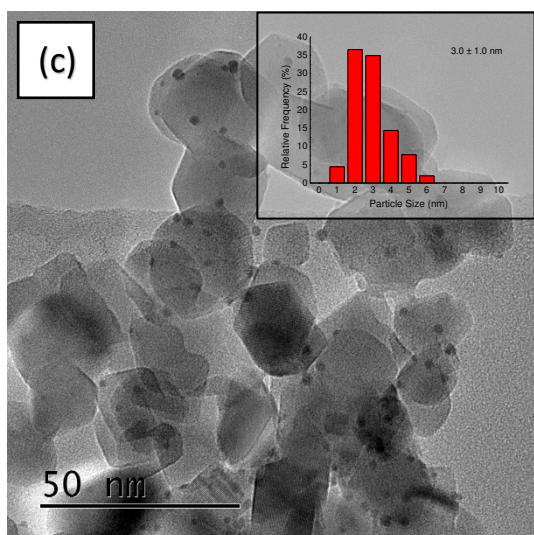
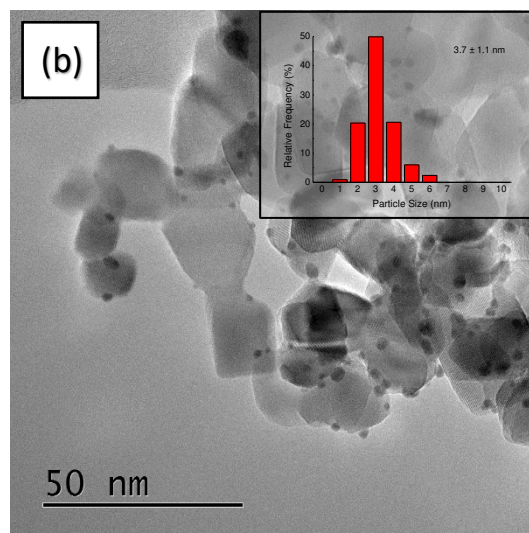
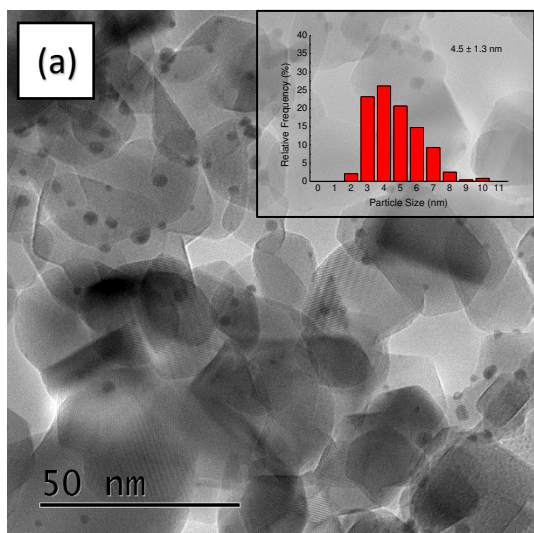


Figure S3: Representative BF-TEM images and (inset) the respective particle size distribution of the various catalysts prepared in batch mode: (a) Au/TiO₂, (b) Au₇₅Pd₂₅/TiO₂, (c) Au₅₀Pd₅₀/TiO₂, (d) Au₂₅Pd₇₅/TiO₂ and (e) Pd/TiO₂.

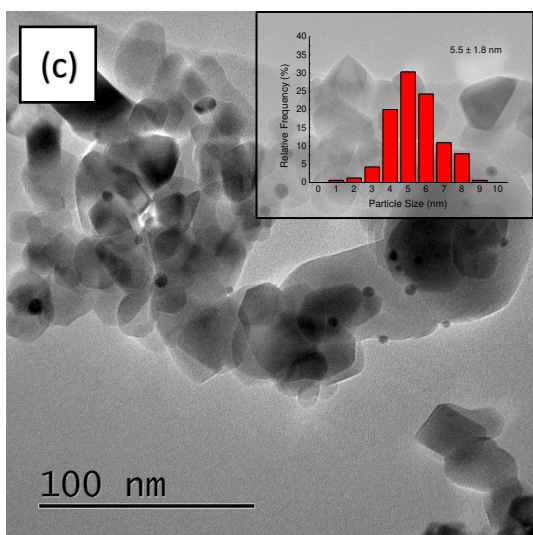
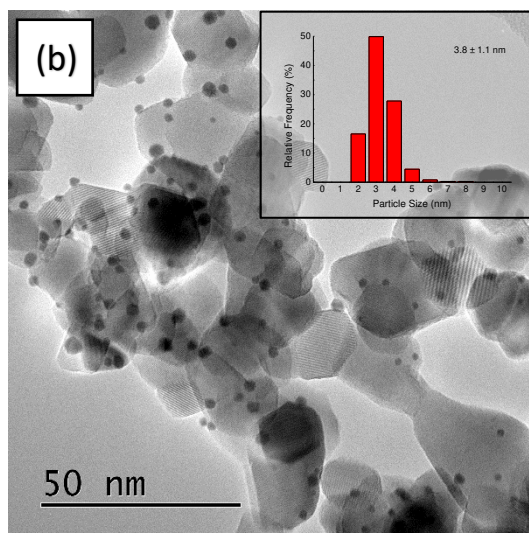
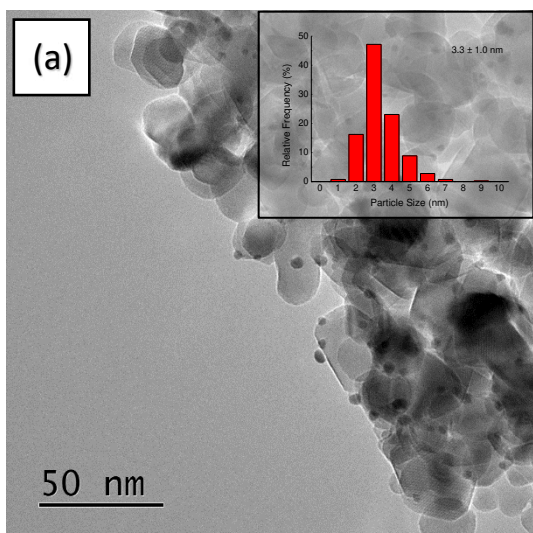


Figure S4: Representative BF-TEM images and (inset) the respective particle size distributions of the Au₇₅Pd₂₅/TiO₂ catalyst prepared in continuous mode and subjected to thermal calcination treatment at (a) 200 °C, (b) 300 °C and (c) 400 °C.

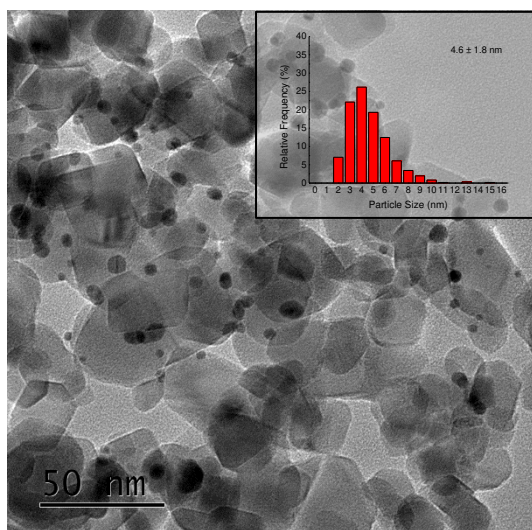


Figure S5: Representative BF-TEM image of the $Au_{75}Pd_{25}/TiO_2$ catalyst prepared in continuous mode and heat treated at 200 °C after the 5th catalysis run. The particle size distribution is shown in the inset.

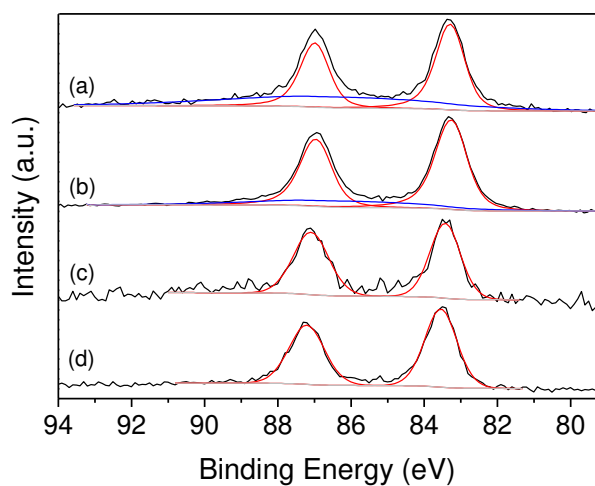


Figure S6: Au4f XPS analysis of the batch-prepared catalysts. (a) $\text{Au}_{25}\text{Pd}_{75}/\text{TiO}_2$, (b) $\text{Au}_{50}\text{Pd}_{50}/\text{TiO}_2$, (c) $\text{Au}_{75}\text{Pd}_{25}/\text{TiO}_2$ and (d) Au/TiO_2 . The red fitting represents the Au^0 , while the blue fitting represents the satellite Pd 4s peak.

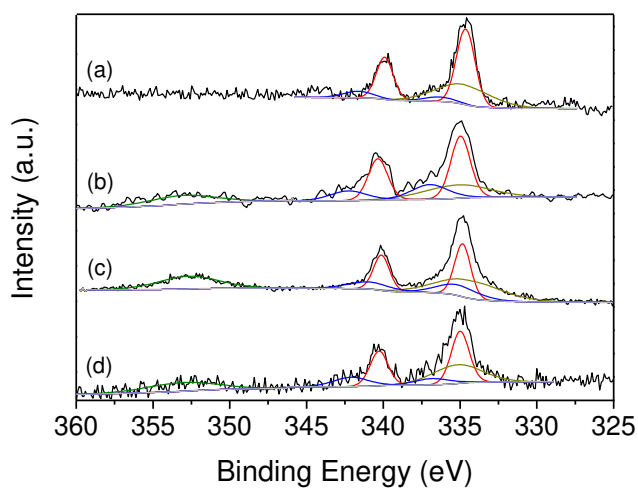


Figure S7: Pd3d XPS analysis of the batch-prepared catalysts. (a) Pd/TiO_2 , (b) $\text{Au}_{25}\text{Pd}_{75}/\text{TiO}_2$, (c) $\text{Au}_{50}\text{Pd}_{50}/\text{TiO}_2$ and (d) $\text{Au}_{75}\text{Pd}_{25}/\text{TiO}_2$. The red fitting represents the Pd^0 , while the blue fitting represents the Pd^{2+} ; the green fitting represents the satellite Au 4d peaks.

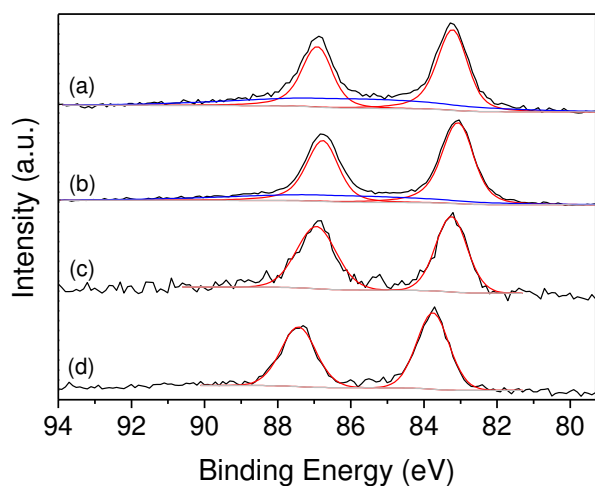


Figure S8: Au4f XPS analysis of the continuous-prepared catalysts. (a) $Au_{25}Pd_{75}/TiO_2$, (b) $Au_{50}Pd_{50}/TiO_2$, (c) $Au_{75}Pd_{25}/TiO_2$ and (d) Au/TiO_2 . The red fitting represents the Au^0 , while the blue fitting represents the satellite Pd 4s peak.

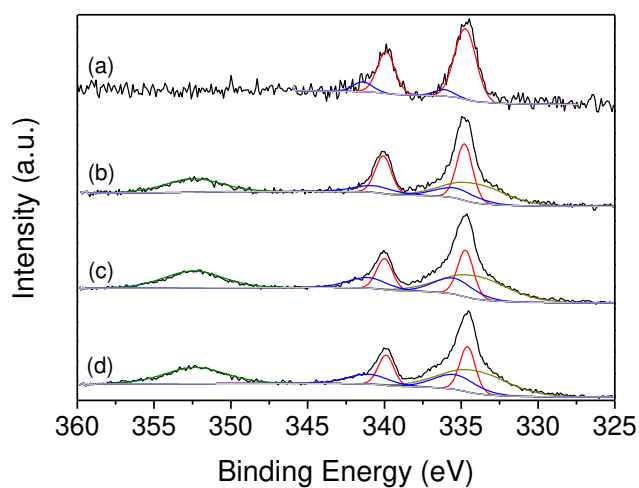


Figure S9: Pd3d XPS analysis of the continuous-prepared catalysts. (a) Pd/TiO_2 , (b) $Au_{25}Pd_{75}/TiO_2$, (c) $Au_{50}Pd_{50}/TiO_2$ and (d) $Au_{75}Pd_{25}/TiO_2$. The red fitting represents the Pd^0 , while the blue fitting represents the Pd^{2+} ; the green fitting represents the satellite Au 4d peaks.

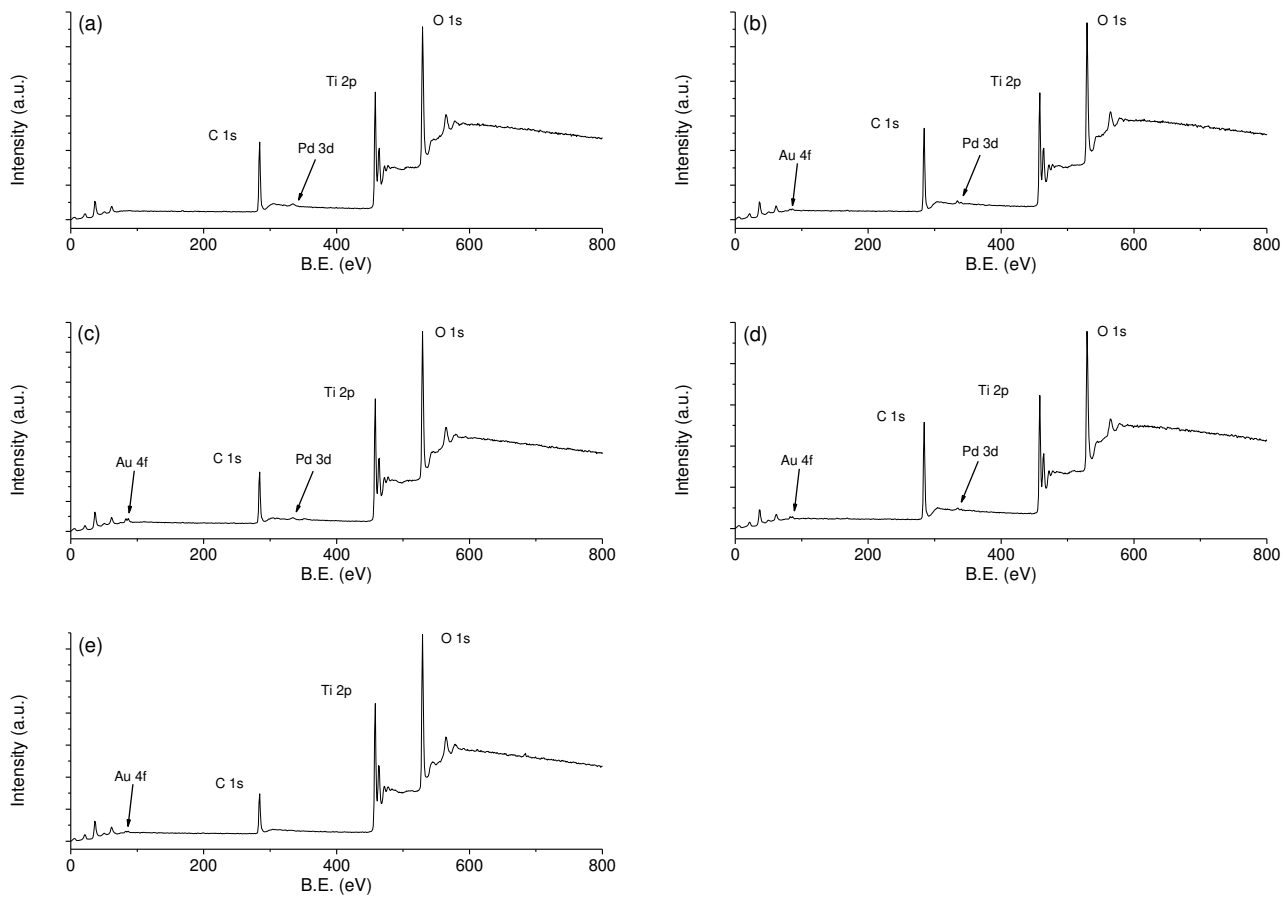


Figure S10: XPS survey scans for the batch-prepared catalysts. (a) Pd/TiO₂, (b) Au₂₅Pd₇₅/TiO₂, (c) Au₅₀Pd₅₀/TiO₂, (d) Au₇₅Pd₂₅/TiO₂ and (e) Au/TiO₂.

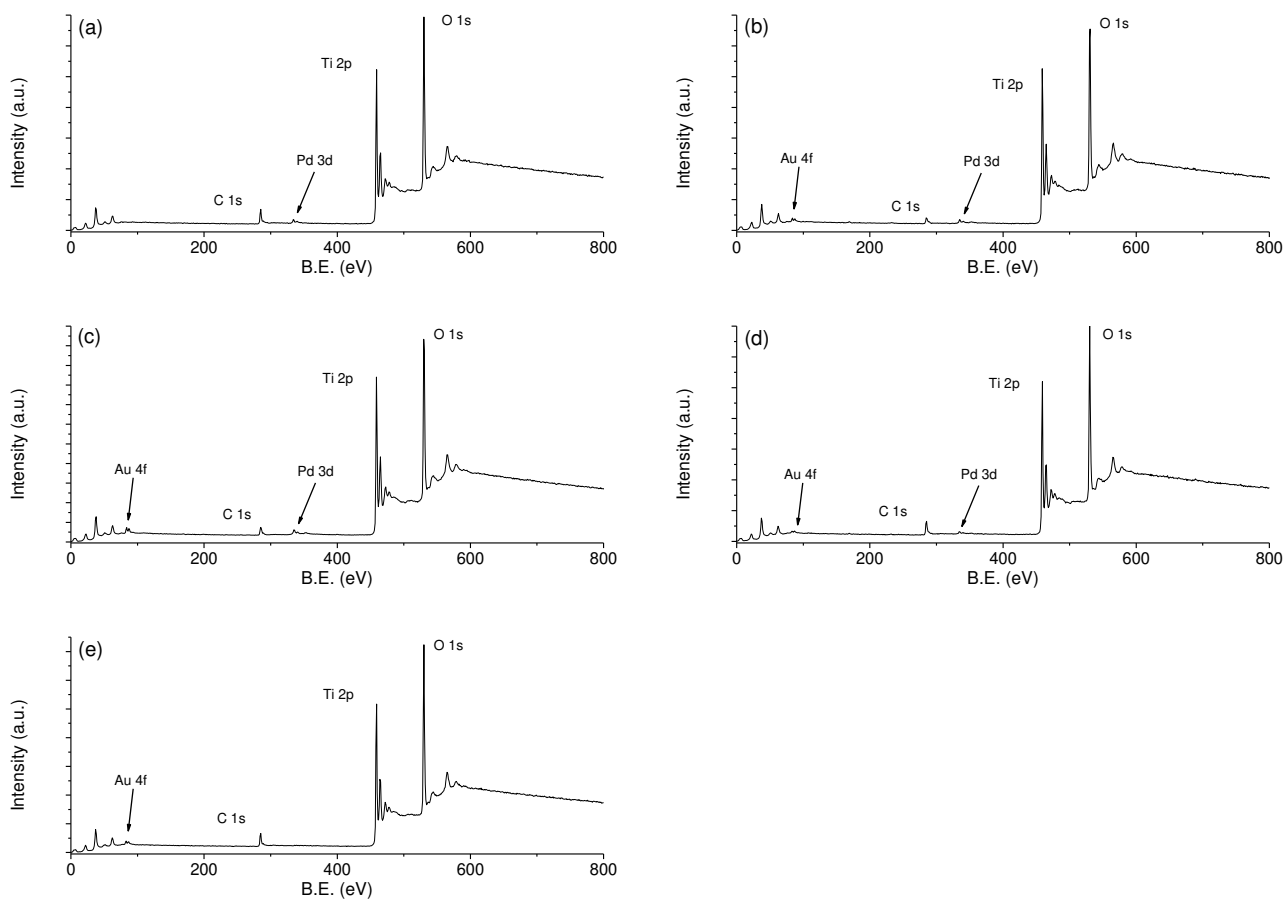


Figure S11: XPS survey scans for the continuous-prepared catalysts. (a) Pd/TiO₂, (b) Au₂₅Pd₇₅/TiO₂, (c) Au₅₀Pd₅₀/TiO₂, (d) Au₇₅Pd₂₅/TiO₂ and (e) Au/TiO₂.

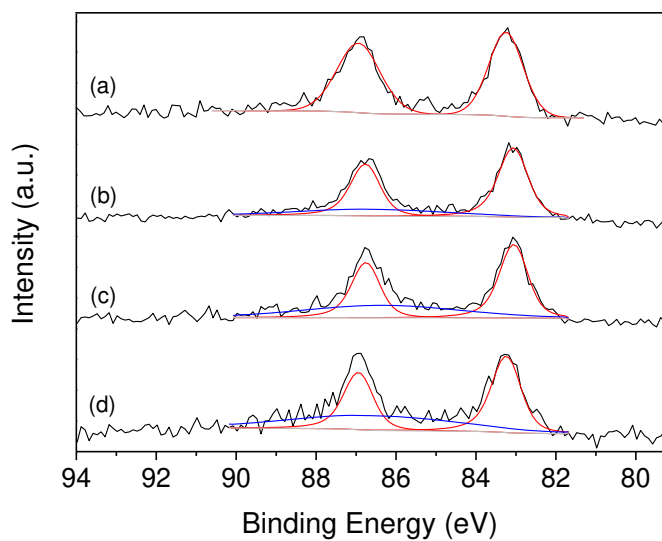


Figure S12: Au4f XPS analysis of the continuous-prepared Au₇₅Pd₂₅/TiO₂ catalysts heat treated at different temperature. (a) untreated, (b) 200 °C, (c) 300 °C and (d) 400 °C. The red fitting represents the Au⁰, while the blue fitting represents the satellite Pd 4s peak.

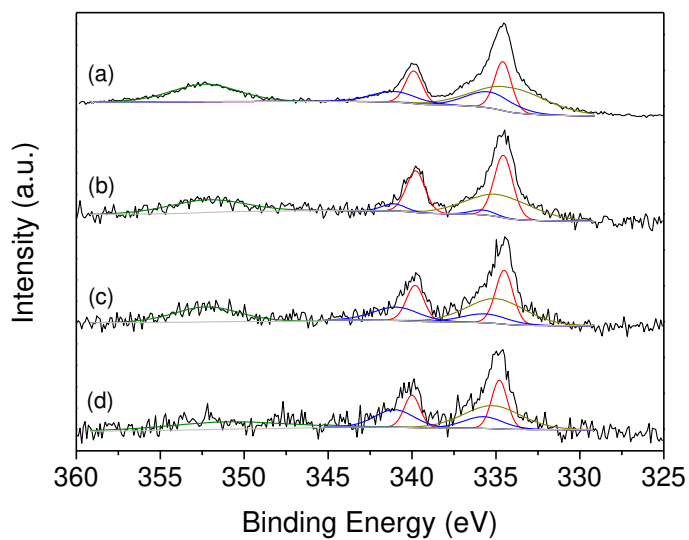


Figure S13: Pd3d XPS analysis of the continuous-prepared Au₇₅Pd₂₅/TiO₂ catalysts heat treated at different temperature. (a) untreated, (b) 200 °C, (c) 300 °C and (d) 400 °C. The red fitting represents the Pd⁰, while the blue fitting represents the Pd²⁺; the green fitting represents the satellite Au 4d peaks.

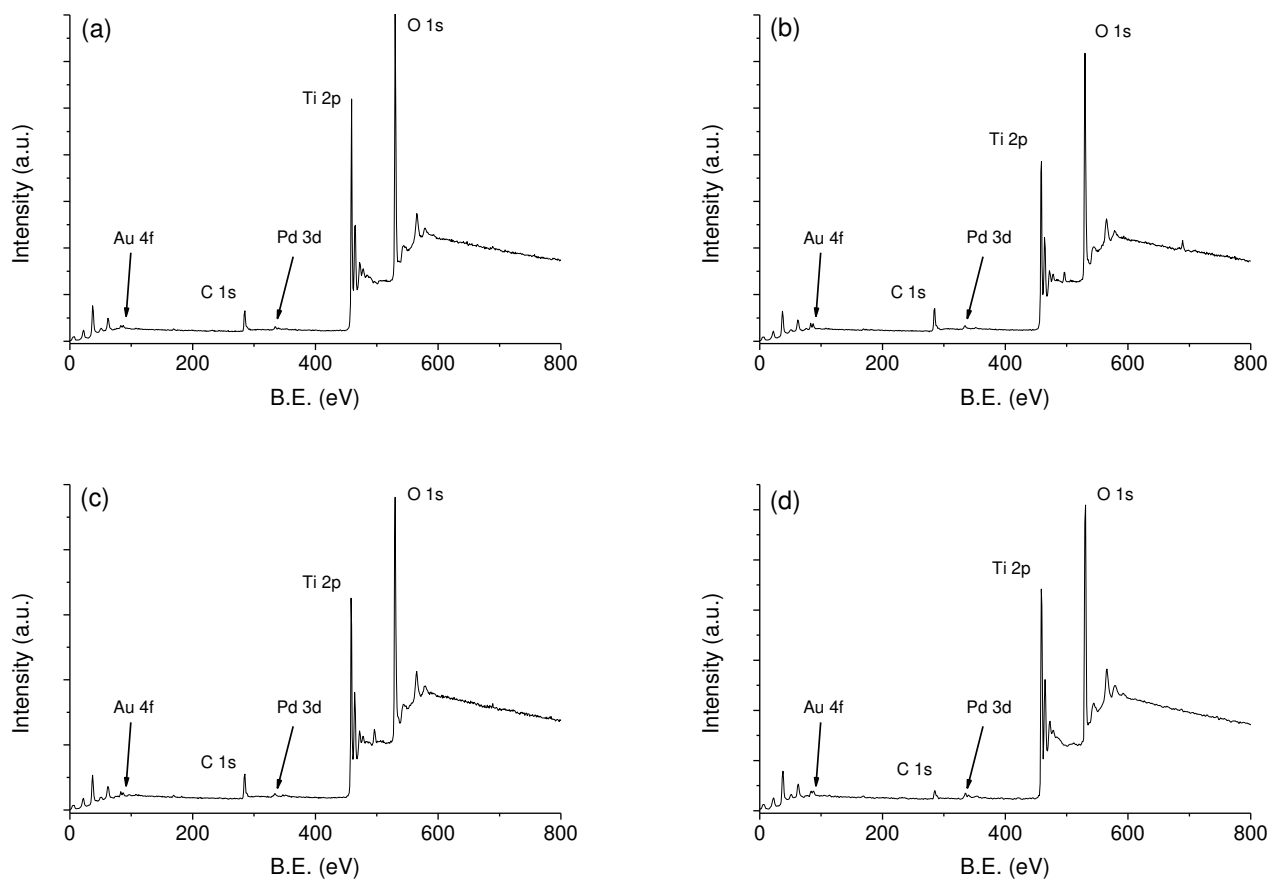


Figure S14: XPS survey scans for the continuous-prepared $\text{Au}_{75}\text{Pd}_{25}/\text{TiO}_2$ catalysts heat treated at different temperature. (a) untreated, (b) 200 °C, (c) 300 °C and (d) 400 °C.

Table S1: Au:Pd molar ratio and Au 4f_{7/2} and Pd 3d_{5/2} binding energy of the catalysts prepared in in continuous (Au₇₅Pd₂₅/TiO₂-C) heat treated at different temperature. The ratios are calculated from XPS quantification.

Catalyst	Au:Pd ratio (mol/mol)	Binding Energy (eV)	
		Au 4f _{7/2}	Pd 3d _{5/2}
Au ₇₅ Pd ₂₅ /TiO ₂ -C	76 : 24	83.2	334.7
Au ₇₅ Pd ₂₅ /TiO ₂ -C-200	72 : 28	83.1	334.7
Au ₇₅ Pd ₂₅ /TiO ₂ -C-300	70 : 30	83.1	334.6
Au ₇₅ Pd ₂₅ /TiO ₂ -C-400	71 : 29	83.2	334.8