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Citation for final published version:

Cattaneo, Stefano, Althahban, Sultan, Freakley, Simon, Meenakshisundaram, Sankar , Davies, Thomas, He, Qian , Dimitratos, Nikolaos , Kiely, Christopher and Hutchings, Graham J. 2019. Synthesis of highly uniform and composition-controlled gold-palladium supported nanoparticles in continuous flow. *Nanoscale* 17 , pp. 8247-8259. 10.1039/C8NR09917K

Publishers page: <http://dx.doi.org/10.1039/C8NR09917K>

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## **Supporting Information**

### **Synthesis of Highly Uniform and Composition Controlled Gold-Palladium Supported Nanoparticles by Continuous Flow**

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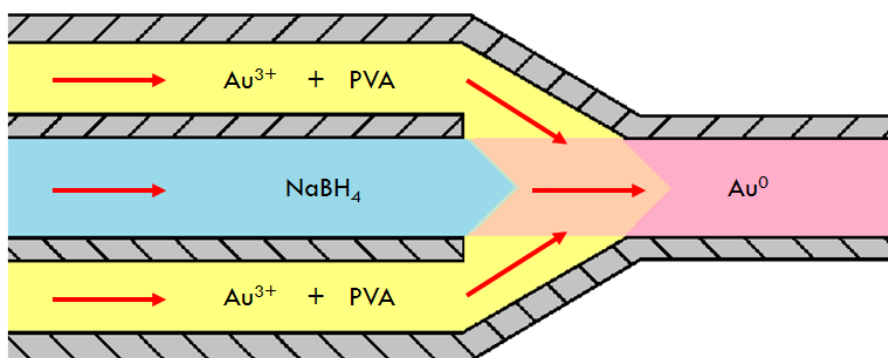
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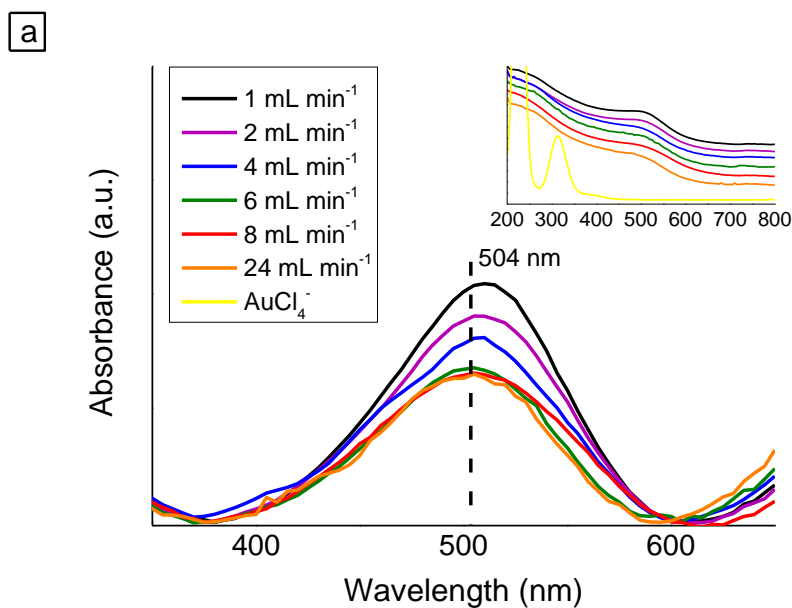
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**Figure S1:** Principle of operation of the I-shape connector geometry, which was found to be optimal in this work.

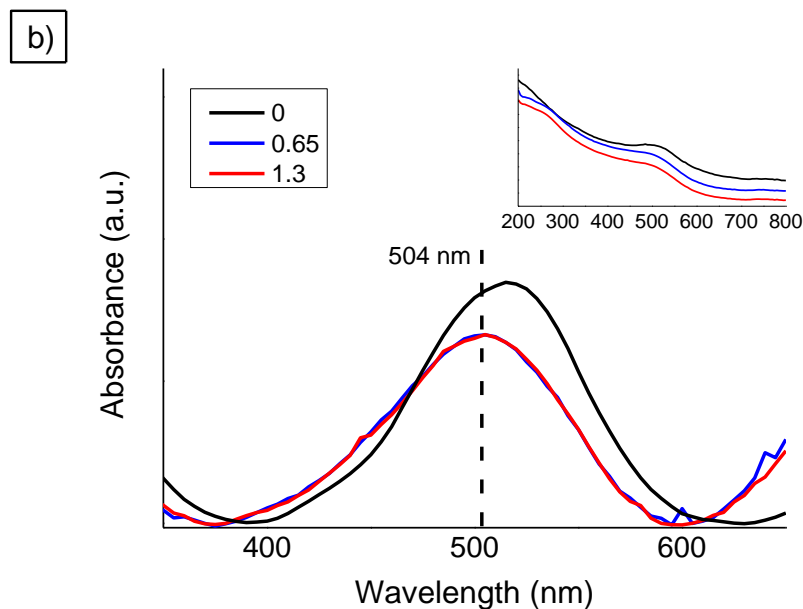


**Figure S2:** All the UV-vis spectra shown here have been processed by baseline subtraction from the original spectra (seen in the inset). The apparent absorption after 600 nm is simply a mathematical artefact caused by the subtraction of a straight line (baseline) and has no scientific meaning.

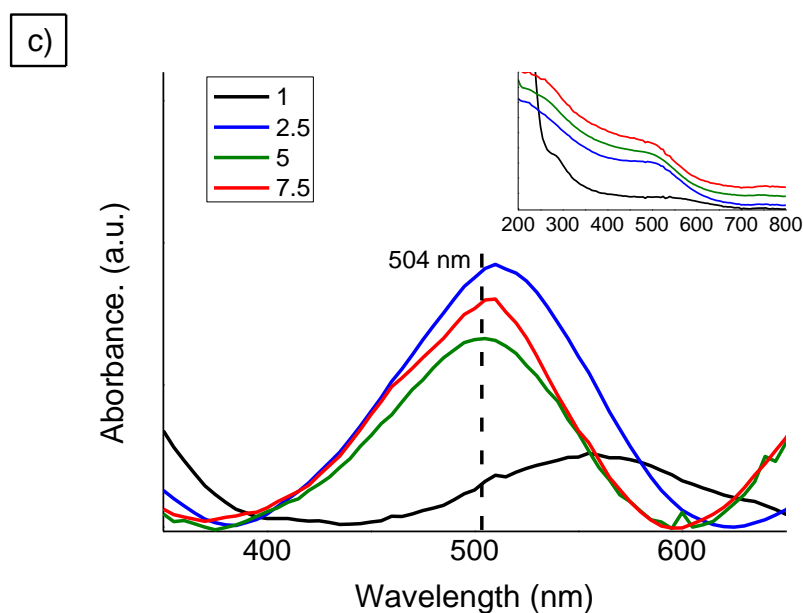
a) UV-vis analysis showing the plasmon resonance feature at different flow rates. The insets show the entire UV-vis spectra and the spectrum of the unreduced metal precursor. The data was recorded using the *in-line* UV-vis flow-cell positioned 50 cm downstream from the T-connection where the Au precursor, PVA and  $\text{NaBH}_4$  first come into intimate contact.



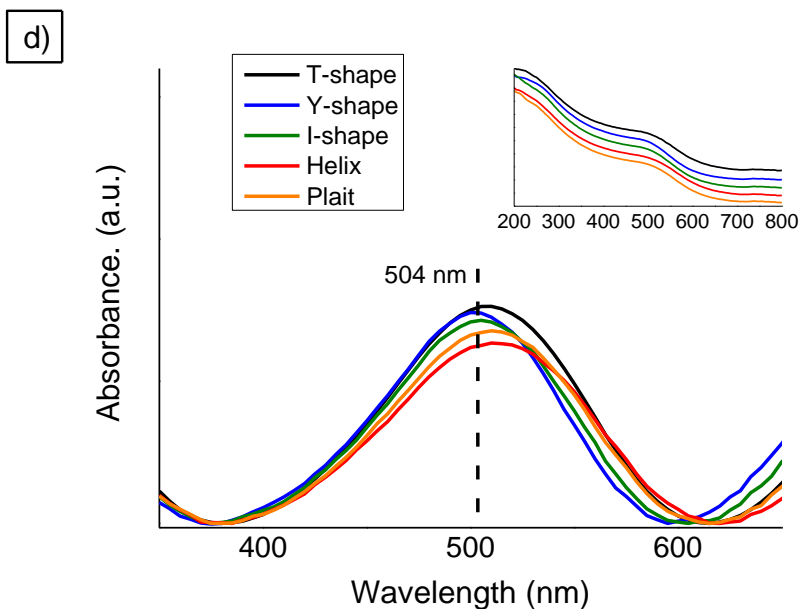
b) UV-vis analysis showing the plasmon resonance for different PVA/Au weight ratios. The insets show the entire UV-vis spectra. The data was recorded using the *in-line* UV-vis flow-cell positioned 50 cm downstream from the T-connection where the Au precursor, PVA and  $\text{NaBH}_4$  first come into intimate contact.



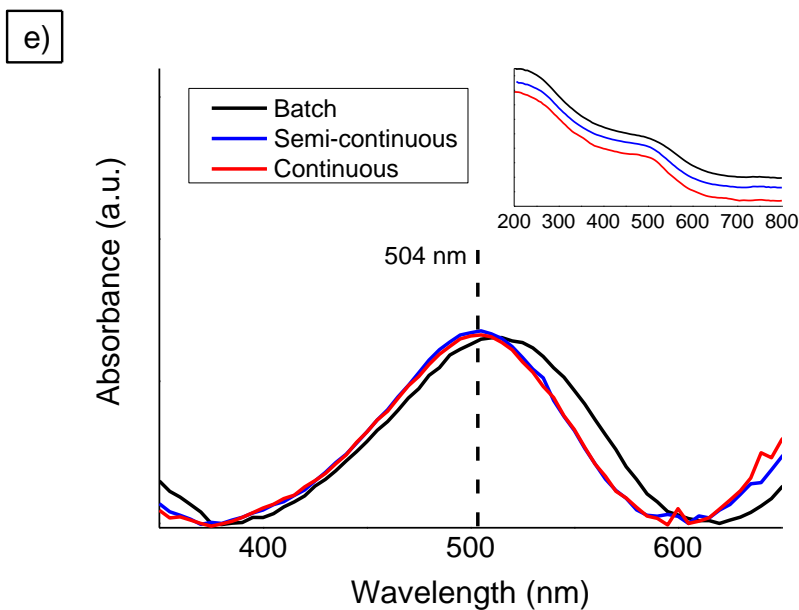
c) UV-vis analysis showing the plasmon resonance for different  $\text{NaBH}_4$ /Au molar ratios. The insets show the entire UV-vis spectra. The data was recorded using the *in-line* UV-vis flow-cell positioned 50 cm downstream from the T-connection where the Au precursor, PVA and  $\text{NaBH}_4$  first come into intimate contact.



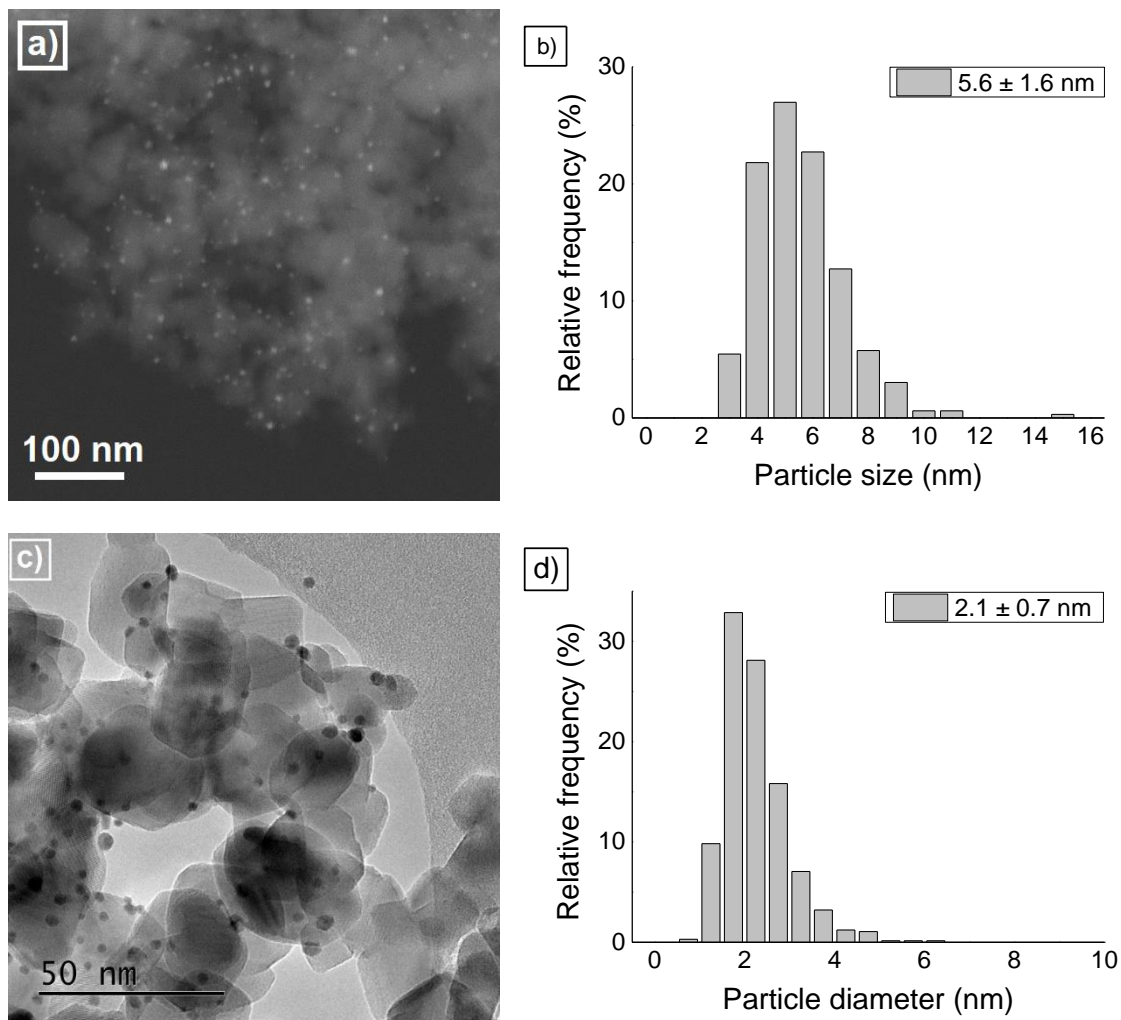
d) UV-vis analysis showing the plasmon resonance with different connector/reactor geometry combinations. The insets show the entire UV-vis spectra. The data was recorded using the *in-line* UV-vis flow-cell positioned 50 cm downstream from the connection where the Au precursor, PVA and NaBH<sub>4</sub> first come into intimate contact.



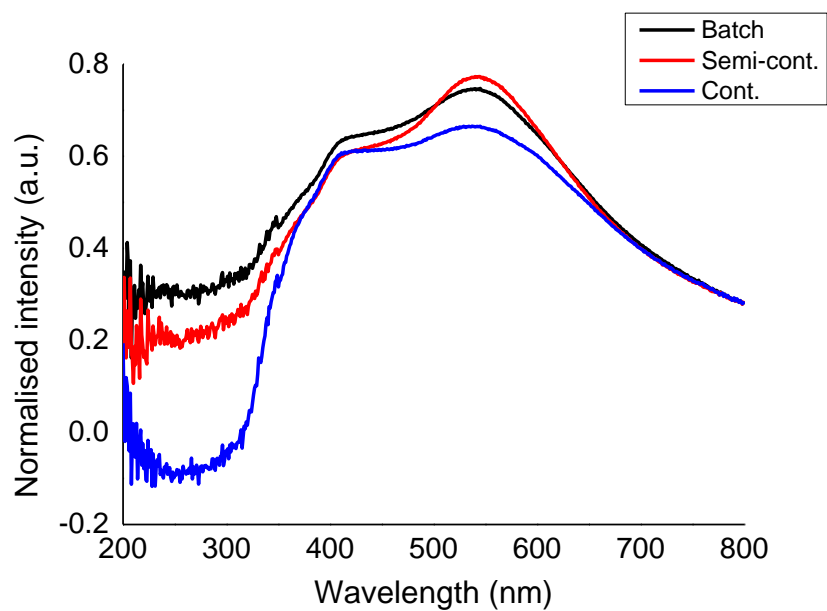
e) UV-vis analysis showing the plasmon resonance with the batch, semi-continuous and continuous synthesis routes. The insets show the entire UV-vis spectra. The data was recorded using the in-line UV-vis flow-cell positioned 50 cm downstream from the T-connection where the Au precursor, PVA and NaBH<sub>4</sub> first come into intimate contact.



**Figure S3:** a) Representative DF-STEM image of the Au/TiO<sub>2</sub> *batch* catalyst with b) its corresponding particle size distribution. c) Representative bright field TEM image of the AuPd/TiO<sub>2</sub> *batch* catalyst with b) its corresponding particle size distribution.

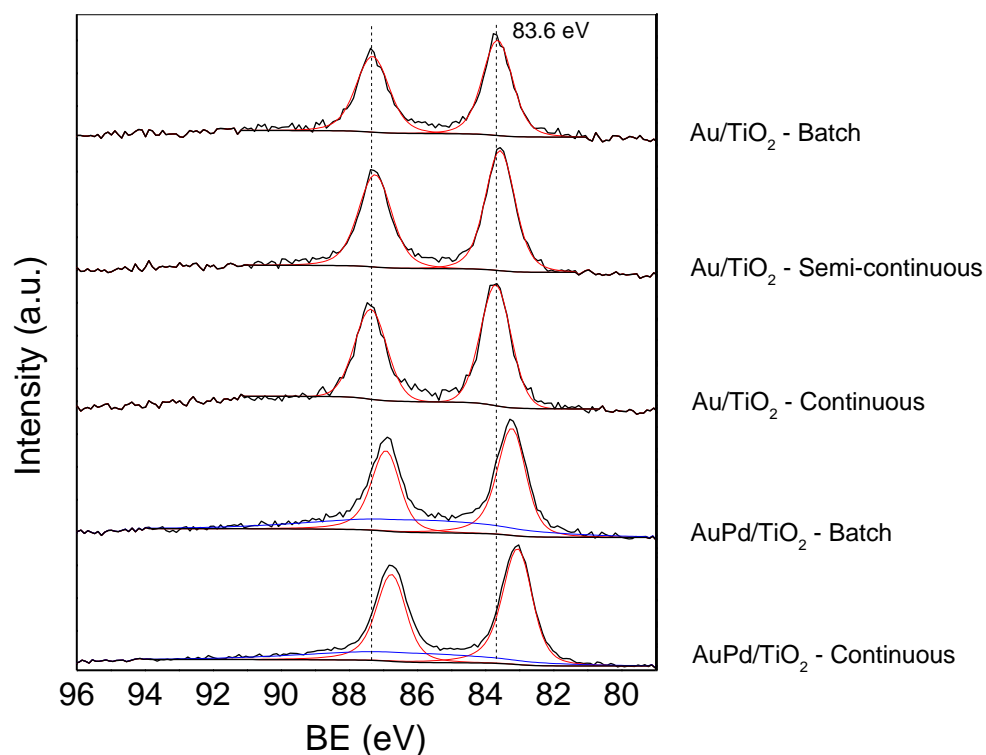


**Figure S4:** Diffuse reflectance UV-vis analysis of the Au/TiO<sub>2</sub> catalysts prepared via the conventional *batch*, *semi-continuous* and *continuous* production methods.

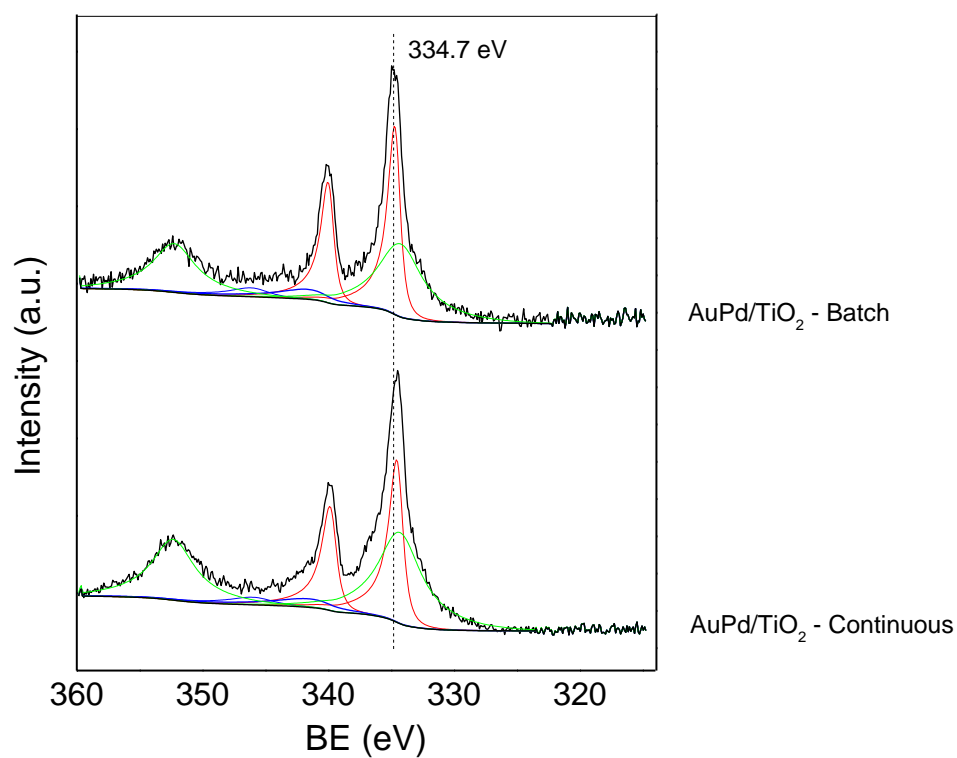




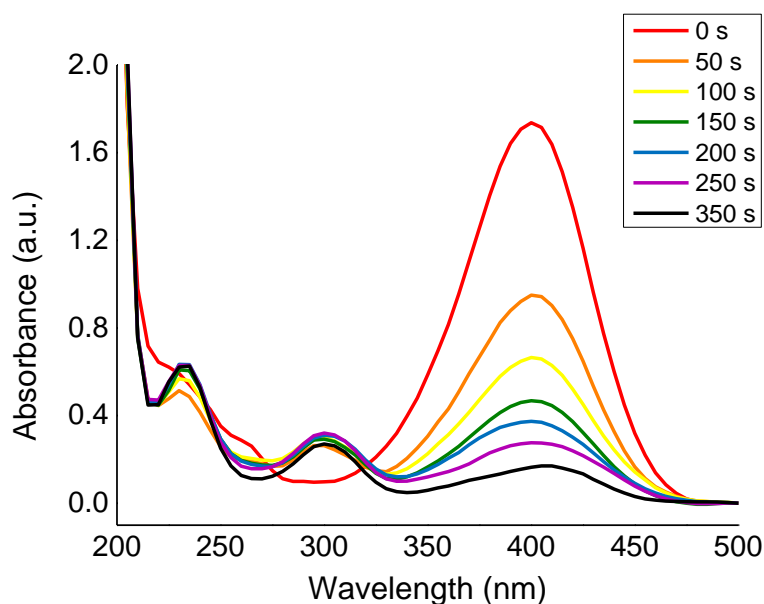
**Figure S5:** a) Au 4f<sub>7/2</sub> XPS spectra obtained from the Au/TiO<sub>2</sub> and AuPd/TiO<sub>2</sub> materials prepared by the *batch*, *semi-continuous* and *continuous* production methods.



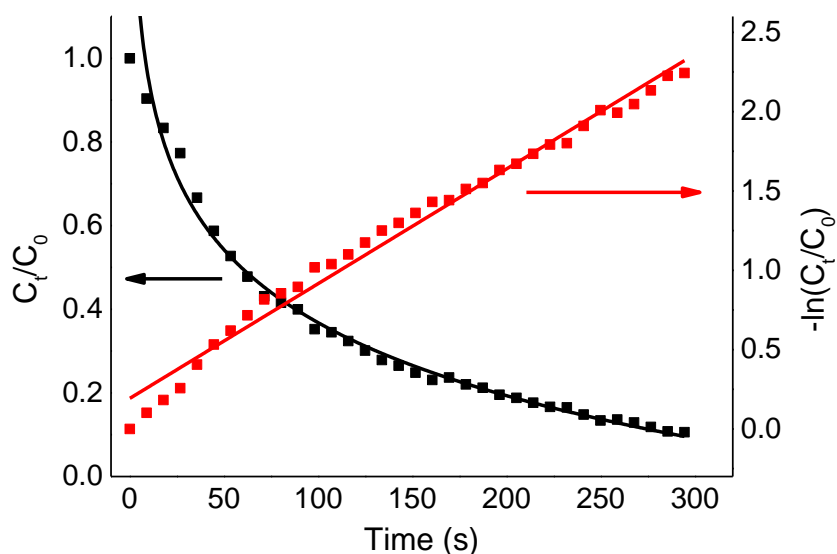
b) Pd 3d<sub>5/2</sub> XPS spectra of AuPd/TiO<sub>2</sub> materials prepared by the conventional *batch* and *continuous* production methods.



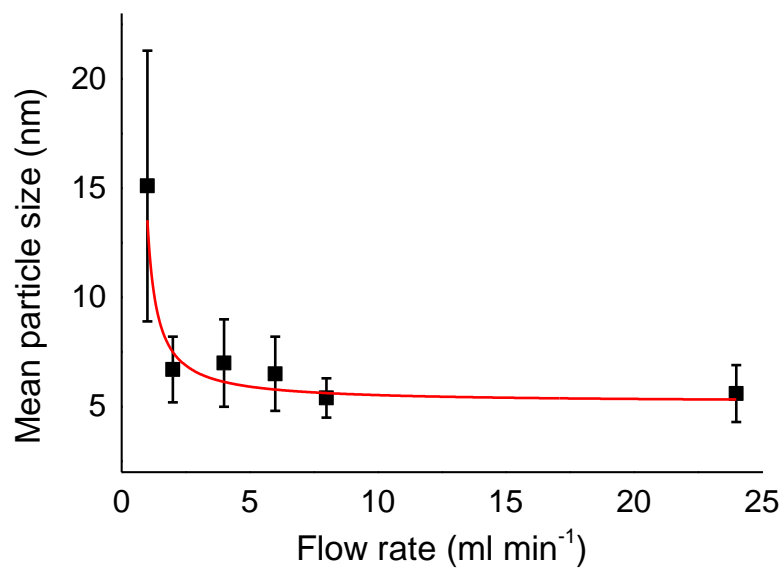
**Figure S6:** a) Typical time sequence UV-vis spectra following the catalytic reduction of 4-NPH reduction (and more generally of NAR reduction) over Au/TiO<sub>2</sub> made using the *continuous* preparation method with an excess of NaBH<sub>4</sub> at room temperature. Molar ratios of Au : NAR : NaBH<sub>4</sub> are 1 : 2.5 : 250.



b) Typical plots of  $C_t/C_0$  (black line) and  $-\ln(C_t/C_0)$  (red line) versus the reaction time for the reduction of NAR catalysed by Au/TiO<sub>2</sub> made using the *continuous* preparation method with an excess of NaBH<sub>4</sub> at room temperature. Molar ratios of Au : NAR : NaBH<sub>4</sub> are 1 : 2.5 : 250.



**Figure S7:** Graphical plot of mean particle size versus flow rate for the continuous production of Au nanoparticles.



**Table S1:** Comparison between the *batch* benchmark, *semi-continuous* and *continuous* derived Au/TiO<sub>2</sub> and AuPd/TiO<sub>2</sub> catalysts showing mean particle size, metal loading, and Au 4f<sub>7/2</sub> and Pd 3d<sub>5/2</sub> binding energies.

Catalyst	Mean NP size [nm]		Metal loading [wt%]	Binding energy [eV]	
	DLS	DF-STEM		Au 4f <sub>7/2</sub>	Pd 3d <sub>5/2</sub>
Au/TiO <sub>2</sub> - batch	5.6 ± 1.7	5.6 ± 1.6	0.94	83.6	-
Au/TiO <sub>2</sub> -semi-continuous	6.0 ± 1.7	5.4 ± 0.9	0.92	83.7	-
Au/TiO <sub>2</sub> - continuous	5.4 ± 1.6	4.5 ± 1.3	0.96	83.6	-
AuPd/TiO <sub>2</sub> - batch	7.7 ± 2.1	2.1 ± 0.7	0.95	83.2	334.7
AuPd/TiO <sub>2</sub> - continuous	7.6 ± 2.3	2.0 ± 0.7	0.94	83.0	334.6

## References

- 1 T. Aditya, A. Pal and T. Pal, *Chem. Commun.*, **2015**, 51, 9410–9431.