Electronic Supplementary Information (ESI)

Gold nanorods or nanoparticles deposited on layered manganese oxide: New findings

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Water oxidation [S1]

Oxygen evolution from aqueous solutions in the presence of cerium(IV) ammonium nitrate, $(NH_4)_2Ce(NO_3)_6$ (Ce(IV)) was followed using an HQ40d portable dissolved oxygen meter connected to an oxygen monitor with digital readout. The reactor was maintained at 25.0 °C in a water bath (Fig. S2). In a typical run, the instrument readout was calibrated against air-saturated distilled water stirred continually with a magnetic stirrer in the air-tight reactor. After ensuring a constant baseline reading, the water in the reactor was replaced with Ce(IV) solution. Without catalyst, Ce(IV) was stable under these conditions and oxygen evolution was not observed. After deaeration of the Ce(IV) solution with argon, Mn oxides as several small particles were added, and oxygen evolution was followed, and oxygen formation rates per manganese ions (detected by AAS) were obtained from linear fits of the data.



Fig. S1 TEM images from gold nanorods (<10 nm diameter, absorption/780 nm, dispersion in H_2O) provided by Sigma-Aldrich company. Scale bar is 10 nm.



Fig. S2 The reactor set-up for oxygen evolution experiment in the presence of Ce(IV).





Fig. S3 SEM (a) and EDX mapping (b: Mn, c: Ca) for A1.



Fig. S4 SEM (a) and EDX mapping (b: Ca, c: Mn, d: Au) for A10.



Fig. S5 FTIR spectra for gold nanoparticles.



Fig. S6 FTIR spectrum for layered Mn-Ca oxide calcined at 60 °C.



Fig. S7 FTIR spectrum for A11.



Fig. S8 FTIR spectrum for A5.



Fig. S9 FTIR spectrum for A6.



Fig. S10 FTIR spectrum for A7.



Fig. S11 The rate of oxygen evolution in the presence of gold nanoparticles (15 mg) ([Ce(IV)]: 0.11 M) at 25 $^{\circ}$ C.

Reference:

S1. M. M. Najafpour, S. Nayeri and B. Pashaei, *Dalton Trans.*, 2011, 40, 9374.