Supporting Information

Low Temperature CO Sensor based on Cataluminescence from Plasma-Assisted Catalytic Oxidation on Ag Doped Alkaline-Earth Nanomaterials

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EXPERIMENTAL SECTION

Reagents and Catalysts

All reagents were of analytical-reagent grade. The reagents of $AgNO_3$, $Fe(NO_3)_3 \cdot 9H_2O$, $CoCl_2 \cdot 6H_2O$, $(CH_3COO)_2Mn \cdot 4H_2O$, NaOH and $NH_3 \cdot H_2O$ were obtained from Beijing Chemical Co. Ltd. The helium gas (99.99%), nitrogen gas (99.99%), argon gas (99.99%), CO, methane, ethane, ethylene and propylene were purchased from Beijing Haipu-Gas Co. Ltd. The nanomaterials supports of MgO, ZnO, and TiO_2 were supplied by Nanjing Haitai Nano. Co. Ltd. Water was deionized and further purified using a Mili-Q water purification system (Millipore, Bedford, MA).

The catalysts of metals loaded on supports of metal oxides were synthesized by sol-gel methods as described in previous works [39]. CL properties were examined by the procedures described previously[27, 39]. Then, the prepared catalysts were spotted orderly onto the surface of a ceramic chip to form a 4 × 4 array (~100 μm in thickness and 1 mm in diameter for each one).

Apparatus and Softwares

CTL responses were recorded using a BPCL-2-JZ-TGC ultraweak chemiluminescence analyzer (Beijing Jianxinlituo Co. Ltd, Beijing, China). The signals of 230-680 nm were obtained by a CR-105 photomultiplier tube (PMT) (Hamamatsu, Tokkyo, Japan). Data acquisition was employed by BPCL software and

exported to Origin 6.0 (Microcal Software, Inc., USA). The imaging procedures were employed by a camera, similar with our previous works [27, 38, 39].

A continuous air flow was provided by a XWK-III oil free air pump (Huasheng Analysis Instrument Co. Ltd, Tianjin, China), which was measured by a flow meter (Beijing Keyi Laboratory Instrument Co. Ltd., Beijing, China). The gas flow of helium, nitrogen or argon out of the cylinder was also controlled by the flow meter. The heating temperature was controlled by a digital temperature controller. A dielectric barrier discharge power supply of 18 W with the an alternating voltage of 3.0 - 3.2 kV (50 Hz) was obtained from Beili Guoke Co. Ltd. (Beijing, China) to sustain the low temperature plasma.

CO Conversion

The gas products of the CO oxidation were collected online and injected into a CP-3800 gas chromatograph (Varian, Walton-on Thames, UK), which was equipped with a dual molecular sieve/porous polymer column and a thermal conductivity detector. Star Chromatography Workstation Ver6.0 (Varian, Walton-on Thames, UK) was used for all GC analyses. The injector was kept at 120 °C, column temperature was set at 45 °C, and flow rate of H_2 gas was kept at 15 mL/min. The corresponding CO conversion was calculated according to the peak area synchronously.

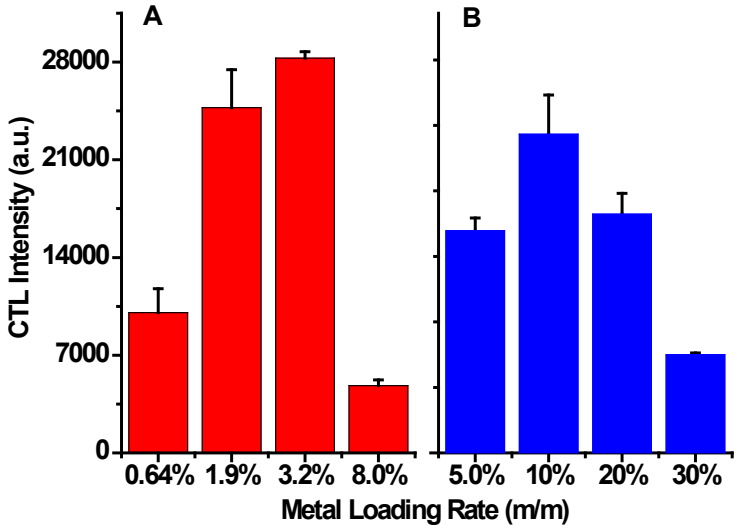

Figure S1. PA-CTL responses of CO oxidation catalyzed by metal-loaded MgO catalysts with different metal loading rates. (A) Ag loaded. (B) Mn loaded. The signals were obtained with an average of three parallel measurements. Working temperature: 50 °C.

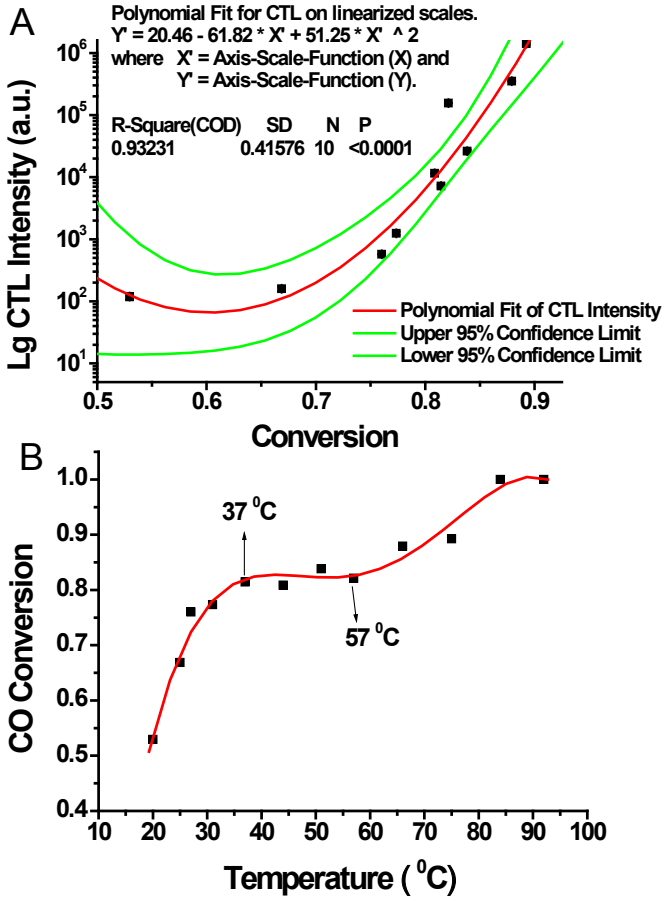

Figure S2. Studies on CO conversion. (A) CO conversion as a function of temperature. (B) Relationship between CTL intensity and CO conversion. The catalyst was 3% Ag/MgO.

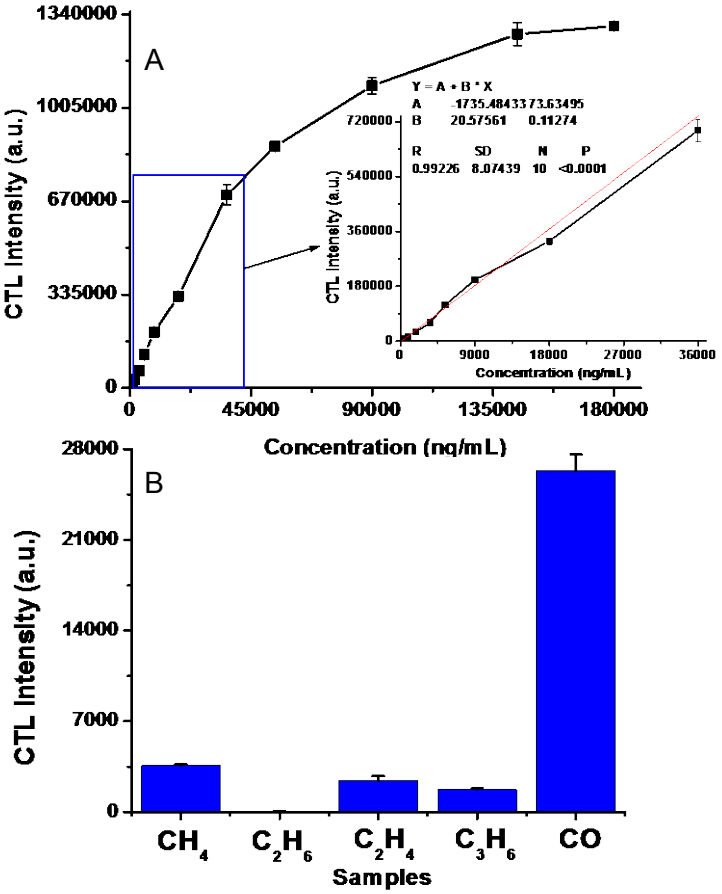

Figure S3. Analysis of CO by PA-CTL-based sensor. (A) Relative CTL intensity as a function of CO concentration. (B) Comparison of CTL signals emitted during the oxidation of different analytes. Each test was repeated three times.