The influence of ceria on Cu/TiO$_2$ catalysts to produce abundant oxygen vacancies and induce highly efficient CO oxidation

Ching-Shiun Chen$^{a,b,*}$, Tse-Ching Chen$^b$, Hung-Chi Wu$^a$, Jia-Huang Wu$^a$, Jyh-Fu Lee$^c$

$^a$Center for General Education, Chang Gung University, 259, Wen-Hua 1st Rd,
Guishan Dist, Taoyuan City 33302, Taiwan, Republic of China.

*E-mail: cschen@mail.cgu.edu.tw

$^b$Department of Pathology, Chang Gung Memorial Hospital Linkou, 5, Fusing St,
Guishan Dist, Taoyuan City 33302, Taiwan, Republic of China

$^c$National Synchrotron Radiation Research Center, Hsinchu 30076, Taiwan, Republic of China
**Fig. S1** Dependence of the relative area of H$_2$-TPR experiments for the reduced Cu/TiO$_2$, CuCe$_x$/TiO$_2$ and CuCe$_5$/SiO$_2$ samples versus the different oxidation time. The as-impregnated Cu samples was calcined in air stream and reduced in H$_2$ at 573 K for 5 h, respectively. The reduced Cu samples were oxidized by a 10% N$_2$O/N$_2$ stream at 343 K.
Fig. S2 N$_2$ adsorption-desorption isotherms of the TiO$_2$, Cu/TiO$_2$ and CuCe$_x$/TiO$_2$ catalysts.
Fig. S3 XPS spectra of Cu $2p_{3/2}$ for the Cu/TiO$_2$, CuCe$_x$/TiO$_2$ and CuCe$_5$/SiO$_2$ samples.
Fig. S4 \( \text{H}_2 \)-TPR profiles of the calcined Cu/TiO\(_2\), CuCe\(_x\)/TiO\(_2\) and CuCe\(_x\)/SiO\(_2\) samples. The as-impregnated Cu samples was calcined in air stream at 573 K for 5 h.
Fig. S5 Temperature-dependent IR spectra of CO adsorbed onto the reduced (A) Cu/TiO\textsubscript{2} and (B) CuCe\textsubscript{10}/TiO\textsubscript{2} samples. CO adsorptions were performed via exposure to a 20 mL/min pure CO stream for 30 min at room temperature, followed by a 20 mL/min helium stream for 50 min to purge the CO gas.
Fig. S6 Temperature-dependent IR spectra of a CO/air stream adsorbed on the reduced Cu/TiO$_2$. A gaseous mixture of 4.5% CO and 2.23% O$_2$ with a flow rate of 50 mL/min was passed through 50 mg of catalyst over the course of CO oxidation.
**Fig. S7** CO-TPR plots of CO$_2$ desorbed from the reduced CuCe$_{10}$/TiO$_2$ and Cu/TiO$_2$ samples in a 100 mL/min CO stream with a 10 K/min heating rate.