Oxidation mechanism of CO with Cu-doped TiO_2 catalyst by in-situ X-ray Absorption Spectroscopy

Xian-Teng Yu(游憲騰)[1], Ying-Rui Lu (盧英睿)[2], Yu-Cheng Huang (黃裕呈)[3,4], Chi-Liang Chen (陳啟亮)[2],Da-Hua Wei (魏大華)[1], K. Thanigai Arul[4,5], Wu-Ching Chou(周武清)[3], Chung-Li Dong (董崇禮)[4*]

[1]*Department of Mechanical Engineering, National Taipei University of Technology, Taipei, Taiwan*

[2]*National Synchrotron Radiation Research Center, Hsinchu, Taiwan*

[3]*Department of Electrophysics, National Chiao Tung University, Hsinchu, Taiwan*

[4]*Department of Physics, Tamkang University, Tamsui, Taiwan*

[5]*Energy and Biophotonics Lab, Department of Physics, AMET (Deemed to be University), Kanathur, Chennai- 603 112, Tamil Nadu, India*

cldong@mail.tku.edu.tw

The metal-modified titanium dioxide catalysts have been widely known as potential catalysts. However, insight the changes in an electronic structure and catalytic reaction mechanism are significantly crucial. For many decades, the advantages of low-temperature catalysis and effective cost reduction have been fascinated by many researchers focus to work on copper modified titanium dioxide. In this work, the heating catalytic mechanism of the Cu-doped TiO_2 is extensively studied by in-situ X-ray Absorption Spectroscopy (in situ XAS) to analyze the oxidation states which leading to catalyze carbon monoxide. The Cu/TiO_2 microparticles were synthesized by aerosol-assisted self-assembly process (AASA) by varying wt % of the TiO_2 microparticles (0, 1, 5, 10, 15 and 20 wt %). The crystal phase and the morphology of the microparticles were analyzed by X-ray diffraction (XRD) and Scanning Electron Microscopy (SEM) respectively. Further, the CO conversion and the distribution of each element were measured correspondingly by gas chromatography (GC) and X-ray fluorescence analysis (XRF). The experimental results are robustly demonstrated that the Cu/TiO_2 (20 wt %) has the highest reaction efficiency at the lowest reaction temperature. Further, in situ XAS analysis showed the oxidation mechanism of the Cu/TiO_2 was Langmuir-Hinshelwood mechanism. Hence, the mechanism of the CO conversion and the oxidation states of the thermally induced Cu/TiO_2 microparticles are realized as an outstanding thermal catalyst and shed a light to develop other advanced TiO_2 based thermal catalysts in the future.