CAMBRIDGE CARES

CAMBRIDGE CENTRE FOR ADVANCED RESEARCH AND EDUCATION IN SINGAPORE LTD.

# Cambridge CARES Visiting Scientist Seminar Series:

## Catalytic conversion of $CO_2$ to fuel


Professor Yang Yanhui

Institute of Advanced Synthesis, Nanjing Tech University


Friday 26 April, 5.00 - 6.00pm

Transformation Room, Level 5, CREATE Tower

C4T Cambridge Centre for Carbon Reduction in Chemical Technology


**Abstract:** In the global attempt to reduce our carbon footprint, the chemical and petrochemical industry faces the problem of replacing the currently used fossil feedstock with renewable resources, reducing energy consumption and intensifying and integrating processes to be more carbon efficient. In all three issues, catalysis will be the key to a successful transformation. Knowledge-based development and implementation of catalytic technology will help to process the novel feedstock, reduce the energy required for maintaining the desired process and improve the carbon efficiency of the targeted synthesis routes. In this seminar, two examples will be discussed to illustrate our efforts in the last year in $CO_2$ utilisation.

The catalytic hydrogenation of $CO_2$ under atmospheric pressure is a hot topic in $CO_2$ utilisation, in which methanation and reverse water-gas shift (RWGS) serve two competing parallel pathways. Novel Ni-W-Mg mixed oxide catalysts ($NiWMgO_x$) were prepared by homogeneous precipitation and attempted for the methanation of $CO_2$. Adding W remarkably promoted the activity with improved stability, anti-CO-poisoning ability and resistance against coke formation compared to the undoped $NiMgO_x$ catalyst.

The control mechanism of catalytic selectivity and structure-activity relation at atomic scale needs further understanding. It has been suggested that the dispersion state and the size of metallic particles play a crucial role in determining $CO_2$ conversion and selectivity as well as stability. However, these studies have not considered the possible effect of interface sites between metal and oxide support in selective hydrogenation of $CO_2$. In this work, three structural configurations of monolayer, periphery and nanocluster in $Ru/Al_2O_3$ catalysts were obtained by control of Ru weight loadings, confirmed by the characterisation results of the extended X-ray absorption fine structure, $H_2$-$O_2$ titration and diffuse reflectance infrared Fourier transform spectroscopy of CO adsorption.


**Biography:** Dr Yang received BS and MS degrees in chemical engineering from Tsinghua University and PhD degree in chemical engineering from Yale University in 1998, 2001 and 2005, respectively. Yang's primary research area is heterogeneous catalysis over metals and metal oxides, in particular, he is interested in understanding the fundamental catalytic concepts and phenomena using well-defined model catalyst and chemically probed reactions. He has published more than 230 research articles and attracted over 8600 citations, H-index 46. Yang joined the School of Chemistry and Molecular Engineering, Nanjing Tech University in 2017 as a full-time faculty member. Yang also served as the Vice-President of Singapore Catalysis Society, Assistant Chair of Graduate Study in NTU, Vice-Dean of the School of Chemistry and Molecular Engineering and Dean of the College of Overseas Education in Nanjing Tech University, China.

CREATE

Campus for Research Excellence And Technological Enterprise

**University of Cambridge**

**Nanyang Technological University**

**National University of Singapore**