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中国科学院上海硅酸盐研究所高性能陶瓷和超微结构国家重点实验室

Methane conversion to high value chemicals by photocatalysis

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报告摘要:

As underlined in the COP26, methane as a greenhouse gas is nearly 80 time more potent than CO2 while its reserve is much more than the sum of coal, oil and natural gas. Thus methane conversion not only involves the environmental issue but also is related to high-value chemical production /clean energy supply, which has been attracting substantial interest over the last decades. However CH_4 activation is energy intensive and kinetically very challenging so that methane activation is regarded as the "holy grail" in the catalytically chemical process. Photocatalysis provides a cost efficient potential to activation of such small molecule under very mild conditions, while to achieve the potential is a huge challenge.

Stimulated by our research outcomes on the charge dynamics in inorganic semiconductor photocatalysis, which reveal that the low reaction efficiency is due to both fast charge recombination and large bandgap of an inorganic semiconductor, together with the recent findings on atomic catalysis, we developed novel material strategies for photocatalytic methane conversion to methanol.

Highly dispersed atomic level iron species immobilised on a TiO_2 photocatalyst show an excellent activity for methane conversion, resulting into ~97% selectivity towards alcohols operated under ambient conditions by a one-step chemical process. Such photocatalyst is also very stable, promising an attractive industrial process of methane upgrade. The dominating function of the iron species has also been investigated in detail. Furthermore, we designed a flow system for relatively efficient methane to C2, achieving the benchmark results in this area. Furthermore, C1 oxygenates can be produced with nearly 100% selectivity by photocatalysis due to the synergy between Au and Cu cocatalysts loaded on ZnO under UV light, or over Pd and oxygen vacancy modified In_2O_3 under visible light irradiation.

报告人简介

Prof. Junwang Tang is a Member of Academia Europaea, a Royal Society Leverhulme Trust Senior Research Fellow, Fellow of the European Academy of Sciences, Fellow of the Royal Society of Chemistry, Fellow of Institute of Materials, Minerals and Mining and Full Professor of Materials Chemistry and Engineering in the Department of Chemical Engineering at University College London.

His research interests encompass photocatalytic small molecule activation (eg. H_2O, CO_2, N_2, C_6H_6 and CH_4) and microwave catalysis (e.g. plastic recycling), together with the investigation of the underlying charge dynamics and kinetics by state-of-the-art spectroscopies. In parallel, he also explores the design of the chemical reactors for the above-mentioned processes, resulting in >210 papers published in *Nature Catalysis, Nature Energy, Nature Reviews Materials, Chemical Reviews, Chem. Soc. Rev. Materials Today, JACS, Angew Chemie, Nature Commu.,* with >21,000 citations. Prof. Tang has also received many awards, the latest of which is the 2021 IChemE Andrew Medal, the RSC Corday-Morgan Prize 2021 and 2021 IChemE Innovative Product Award, besides the Runner-up of IChemE Research Project 2020, IChemE Business Start-Up Award 2019 and the 2018 IPS Scientist Award etc. He also sits on the Editorial Board of four international journals, eg. the Editor *of Applied Catalysis B* and Editor-in-Chief of *Journal of Advanced Chemical Engineering,* Associate Editor *of Chin. J. Catal.* and *Asia-Pacific Journal of Chemical Engineering* besides sitting on the Advisory Board of 7 other journals.