ISGC 2022

N°1412 / KN
TOPIC(s) : Energy

Solar fuels from CO2 photoreduction in gas phase: Challenges and Strategies

AUTHORS
Audrey BONDUELLE / IFPEN, IFP ENERGIES NOUVELLES, PARIS

PURPOSE OF THE ABSTRACT

The increase in CO2 emissions, and consequently the increase in CO2 concentration in the atmosphere, as well as the depletion of fossil fuels, raises many concerns about global warming and the world's energy supply. Therefore, as an alternative and sustainable method, the photocatalytic reduction of CO2 into valuables molecules or solar fuels could prove particularly relevant.[1] For instance, having a robust process to convert CO2 from plant chimneys directly into the gas phase would reduce more than 50% of global emissions of this greenhouse gas.

The photocatalyst is usually a multifonctional material which absorbs light, separates the photogenerated charges, transports them to the surface, and provides active sites for the catalytic reaction.[2] Each of these steps encounters critical limitations which prevent the overall photoconversion efficiency and selectivity of CO2 reduction and industrial development.

At IFPEN, we intend to develop new materials to explore these different challenges. These materials are dedicated to the production of CH4 and longer alkanes molecules and are tested on a photocatalytic unit, whose test conditions are representative of those of a plugged process at the exit of plant chimneys.

In this presentation, we propose to present some highlights of our team: addressing light diffusion within the photocatalyst by proposing a 3D photoconversion behavior with the use of macrocellular monoliths[3,4], and fine tuning optical properties of low bandgap semiconducting Transition metal oxy-sulfide based materials.[5,6]

Target photocatalytic performances for industrialization will also be discussed.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

CO2 photoreduction | solar fuels

BIBLIOGRAPHY

[1] S. N. Habisreutinger, L. Schmidt-Mende, J. K. Stolarczyk, Angew. Chem. Int. Ed., 2013, 52, 7372.

[2] X. Chang, T. Wang, J. Gong, Energy Environ. Sci., 2016, 9, 2177.

[3] S. Bernadet, E. Tavernier, D-M.Ta, R. A. L. Vallée, S. Ravaine, A. Fécant, R. Backov, Adv. Funct. Mater., 2019, 29, 1807767.

[4] S. Bernadet, A. Fécant, S. Ravaine, D. Uzio, R. Backov. FR Patents N°. 3065651, 3065650, 3065649, 2017.

[5] A. Fécant, A. Bonduelle. Patent filing FR Patent N° 3073429, 2017.

[6] M. Shahrokhi, M., P. Raybaud, T. L. Bahers, J. Mater. Chem. C, 2020, 8, 9064.