

Field:

Chemistry/Material Science

Session Topic:

Chemical Solutions for Carbon Resource Issues

Introductory Speaker:

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Recently, the development of low-carbon fuels for substituting fossil fuels has paid much attention. A low-carbon fuel is defined to be one for which the amount of CO₂ emitted during combustion is low. Some typical low-carbon fuels are hydrogen gas, methanol, and ethanol. For the production of these fuels, it has become imperative to devise methods that require no fossil resources. Since CO₂ is the main greenhouse gas, it is necessary to take into account the mitigation of this gas when formulating the global environmental protection measures. At the 2009 U.N. Summit on Climate Change held at New York, the former Prime Minister of Japan Mr. Yukio Hatoyama said, "Japan administration would aim to cut greenhouse gas emissions by 25% by 2020 from 1990 levels". From these social backgrounds, production of low-carbon fuels by using renewable energy such as solar energy, biomass resources is important for mitigating global warming.^[1] After the Fukushima Daiichi nuclear disaster following the 9.0 magnitude Tohoku earthquake and tsunami on 11 March 2011, the conversion from the nuclear power to renewable energy is urged in worldwide.

Major purpose of this session is to discuss the "*Chemical Solutions for Carbon Resource Issues*" from the many different points of view such as photochemistry, photocatalyst, biotechnology, biocatalyst, artificial photosynthesis and so on. In this session, production technologies of low-carbon fuels are classified into three categories.

First category is the solar hydrogen production from water based on the artificial photosynthesis using functional photocatalyst and bioinspired system. Especially, photocatalytic water splitting has paid much attention for the production of hydrogen and oxygen by directly solar light utilization in this category.

Second category is the biofuel production such as ethanol from biomass using the biocatalysis and biotechnology. For example, biomass ethanol so called "Bioethanol" is a production of renewable energy that can be obtained from agricultural feed stocks fermentation. Bioethanol will be in replacing gasoline in the future.

Final category is the artificial photosynthesis system for solar fuel production from CO₂. CO₂ fixation is a potential technology for photocatalytic CO₂ reduction and synthesis of organic compounds from CO₂ as the starting material. For example, the low-carbon fuel, methanol production from CO₂ is accomplished using the artificial photosynthesis system consisting of the photosensitizer molecule and three dehydrogenases (formate, aldehyde and alcohol dehydrogenases).

Here, above mentioned social background and scientific aspects are explained in detail, and show some actual examples of low-carbon fuel production technology.

Reference

[1] Y. Amao, *ChemCatChem*, **2011**, *3*, 458-474.