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Editorial

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Carbon Capture and Conversion

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Introduction

Measuring and reducing exposure to carbon dioxide is one important step towards developing reduced risk industry. With the abundance of fossil fuels in the absence of a cost-effective alternative energy source and the continued reliance of global markets on this sort of energy, the carbon-capture technology is becoming a viable means of reducing CO_2 that releases into the atmosphere [1]. In addition to current strategies that are developed for carbon capture and storage, many other technologies are also available for in-situ CO_2 conversion to valuable products.

Such technologies include hydrogenation of CO_2 through high temperature–pressure processes. Nevertheless, the above reactions are costly with the significant energy required for the CO_2 reduction, and the efficiency is still a great challenge. One alternative could be photocatalysis in which photons that are coming from the Sun or a light source hit on a photocatalyst and proceed reduction reactions which produce H_2 derived from H_2O, and CH_3OH and CH_4 derived from CO_2 reduction [2]. A photocatalytic process relies on the reaction between excited charges in semiconductor, that have been generated by the absorption of light, with the components presented in the environment, leading to the production of desired materials. The resulting products depend upon the semiconductor properties and the choice of reductant.

Researchers are required to actively investigate how specific constituents of carbon-based molecules (especially CO_2) might be selectively reduced or removed, and develop innovative technologies to improve the selectivity and conversion. Works on using a new photocatalytic reactor structure with novel design features, and novel semiconductor oxides such as Titania Nanotubes and Nanosheets which have shown highly efficient reduction capability for the most of the harmful compounds in the environment are in great demand [3]. Also, there are a number of design considerations to create an efficient photocatalytic conversion unit with improved charge separation, and directional electron transfers by trapping promoted electrons/holes through using a sacrificial reagent or selecting the best semiconductor material with the optimal overlap of band gap with the wavelengths of light, to achieve the desired photocatalytic products.

Another technology, which is being demonstrated in pilot scale, uses CO_2 to desalinate industrial wastewater, creating a smaller carbon footprint and an economical alternative to conventional desalination. This waste-to-value technology facilitates the reaction between salts present in industrial wastewater and CO_2 in an electrochemical cell to convert the CO_2 into high-value chemicals such as carbonate salts and acids that are particularly useful for the oil and gas industry [4]. Other alternative route for CO_2 removal is the use of photovoltaic cells that convert the solar energy into electricity, which is then used to electrochemically reduce CO_2 on metal electrodes. In this context, the use of an electro-bioreactor containing lithoautotrophic microorganism is also possible.

In contrast to technologies which try to address each issue separately, the coupling of both processes is unique and is highly recommended for industry. So the recent innovations in carbon capture technology and photocatalytic processes can effectively be applied for CO_2 removal through simultaneous converting to marketable products.

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