Abstract for the 6th Conference on Carbon Dioxide as Feedstock for Fuels, Chemistry and Polymers

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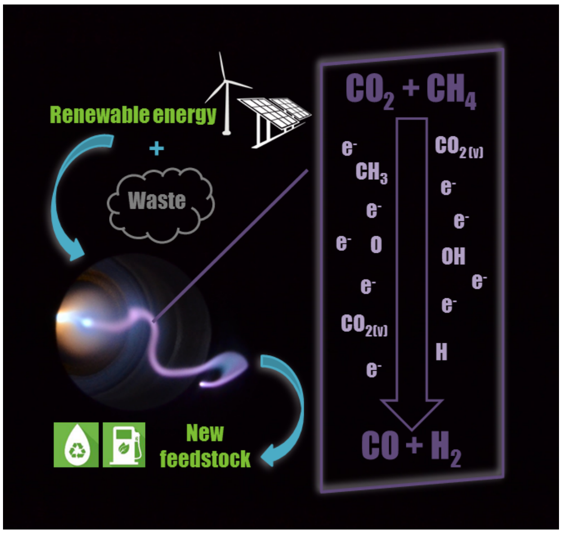
Carbon dioxide as feedstock for value-added chemicals and fuels in a Gliding Arc Plasmatron



Within our research group PLASMANT, we study the use of plasmas for CO_2 conversion by means of experiments as well as computer simulations. Plasma can be created by applying electric power to a gas, causing breakdown of the gas into ions and electrons. It is thus a (partially) ionized gas, consisting of molecules, but also a large number of other species, such as various radicals, ions, excited species, and electrons. This makes plasma a highly reactive cocktail, useful for many applications, including the conversion of carbon dioxide into value-added chemicals and fuels. The major advantage of plasma is that mainly the electrons are heated by the applied power, because of their small mass, and the energetic electrons can activate the gas by electron impact excitation, ionization, and dissociation, creating reactive species that can easily form new molecules. In this way, the gas as a whole does not have to be heated. Furthermore, owing to the fact that plasma can be switched on and off very easily, this technique also has great potential to store intermittent renewable energy, like solar and wind. Therefore, the use of plasma for CO_2 conversion might be a solution for three important problems, i.e., global warming, our dependency on fossil fuels for production of chemicals and fuels, and storing renewable energy.

Several types of plasmas are being investigated for CO_2 conversion. One of them, the Gliding Arc Plasmatron (GAP), has shown to be very promising in terms of energy efficiency. We already reached an energy efficiency of 66 % at a total conversion of 28 % in a CO_2/CH_4 mixture, mainly producing syngas ($CO + H_2$). We also performed experiments in pure CO_2 as well as in CO_2/N_2 mixtures. The latter were carried out to investigate whether CO_2 capture is necessary or whether a waste stream can immediately be converted without separation, leading to combined CO_2 conversion and N_2 fixation. In order to better control the reaction products, we plan to add a catalyst to the system in our future experiments. The main goal of our research is to obtain a better understanding of the CO_2 conversion in this type of plasma reactor and how this process can operate in an energy-efficient way for implementation of this technique in industry as soon as possible.