Plasma Catalysis for CO2 reduction using liquid water as hydrogen source

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Reacting CO2 with H2O is an interesting way to obtain valuable compounds from available and cheap sources while at the same time recycling carbon dioxide. This is specially promising if liquid compounds can be generated since those are easier to transport and store. Plasma is a suitable technique to convert CO2, but using gaseous CO2 + H2O it does not lead to liquid products [1], while the use of liquid water proved to be able to achieve molecules as long acetic acid [2]. To further study this system, we bubbled CO2 either into pure water or into water with suspended catalyst particles (a slurry), catalysts chosen were MnO, Mn2O3, Mn3O4 and MnO2. The needle where the CO2 is added into the system also works as the high voltage electrode and plasma discharges form in the interior of the bubble. Using a high-speed camera, it was possible to obtain images from plasma developing in different stages of the raising bubble and to properly correlate those with the amount of power injected. Furthermore, the outlet gas was analyzed by Fourier-transform infrared spectroscopy (FTIR), the liquid after the discharge was analyzed by Total Organic Carbon, Time-of-flight mass spectrometry (TOFMS) and by evaporating the water it was able to collect a solid-like substance that was also analyzed by FTIR. Those confirmed the conversion of CO2 to CO in gas-phase and long-chain organic products as Tridecanoic Acid remaining in the liquid phase. Also, it was possible to observe the effect of the discharge on the catalysts, where the lower oxidation states of manganese in the oxides were less stable and were more prone to be partially converted into MnCO3.

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References

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