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High-pressure photoreactor for CO_2 conversion to fuels

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CO_2 capture and storage is a fundamental research topic in order to decrease the concentration of such greenhouse gas. A new and challengingprocedure is the CO_2photoreduction to alcohols and alkanes in the presence of a semiconductor.Unfortunately, the efficiency of the process is largely restricted by two factors: 1) the limited solubility of CO_2 in water especially at relatively high temperature; 2) the inadequate visible light absorption of the UV-active catalysts. In literature, most of the studies were performed using reactors of different shape and type, but always working at atmospheric pressure.
In this research, we tested a novel concept of photoreactor developed by our group [1] able to operate under high pressure (up to 20 bar) and to explore different temperature ranges.Through this set up we can explore unconventional operating conditions, so overcomingthe key limitation of CO_2 solubility, and increase the operating temperature,thus improvingthe overall kinetic of the process. Na_2SO_3 has been employed as inorganic hole scavenger. TiO_2loadedwith Au was chosen as photocatalyst. Different titania polymorphs (rutile, anatase, P25) and metal loading (0.1%, 0.2%, 0.5%) were chosen, to confirm the effect of the physicochemical properties of the catalysts on reactivity. The samples were prepared by deposition-precipitation and characterized by traditional techniques (XRD, BET, TEM, UV) combined with specific in situ analysis (DRIFTS).
The operating conditions (pressure, temperature, pH, irradiation power) have been varied allowing the investigation of several possible applications of this reactor. In particular we focused our attention onthe maximization of gas phase products ($H_2$and CH_4) with respect to liquid phase organic compounds (mainly methanol and formaldehyde).

Keywords: *CO_2protoconversion; CO_2protoreduction; photoproduction of fuels*

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References

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