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Simple photochemical reduction of carbon dioxide to formate under mild acidic conditions

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Carbon dioxide, is a very stable component of ambient air and atmospheric levels have been rising due to emissions from combustion of fossil fuels. There is a need to develop remediation techniques and carbon dioxide serves as a feedstock for conversion to other useful products such as methanol, formaldehyde, formic acid, oxalic acid, formate, methane, saturated and C2-C4 unsaturated hydrocarbons. Carbon dioxide can be converted into these products using different methods such as photochemical, electrochemical, thermochemical and hydrogenation by bacterial depending on the product of interest. Formate is of interest due to having wide industrial applications, which include direct liquid fuel cells (DLFCs) production, an additive in pyrolysis vapors, precursor for biological fuels and histidine synthesis and a key intermediate in methanogenesis breaking down complex organic compounds. In this work, conversion of carbon dioxide to formate was accomplished photochemically. Titanium dioxide and various metal phthalocyanines under acidic conditions were saturated with carbon dioxide and illuminated using an incandescent light source. Formate was determined by ion chromatography.

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