Carbon dioxide: a waste, a raw material. Fate or Opportunity.
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Solar Processing of CO_2 and H_2O, Routes for Solar Fuels.

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Concentrated solar energy provides heat in the temperature range 200°C-3000°C for concentration ratio variation from 10 to 10 000 (three orders of magnitude). Consequently, solar-driven thermochemical processes may be proposed to produce hydrogen from water decomposition and to reduce carbon dioxide. This lecture gives an overview of such processes.
High temperature thermochemical cycles for hydrogen production by water splitting are currently studied at PROMES lab, particularly 2-step and 3-step cycles based on the following reaction scheme,

$$MO_{ox} \rightarrow MO_{red} + ½\ O_2 \text{ (high temperature solar step)}$$
$$MO_{red} + H_2O \rightarrow MO_{ox} + H_2 \text{ (low temperature non solar step)}$$

Volatile and non-volatile oxide cycles are developed from the chemical and the engineering points of view.
A similar reaction scheme may be proposed to reduce carbon dioxide with concentrated solar energy (Fig. 1), it comes,

$$MO_{ox} \rightarrow MO_{red} + ½\ O_2 \text{ (high temperature solar step)}$$
$$MO_{red} + CO_2 \rightarrow MO_{ox} + CO \text{ (low temperature non solar step)}$$

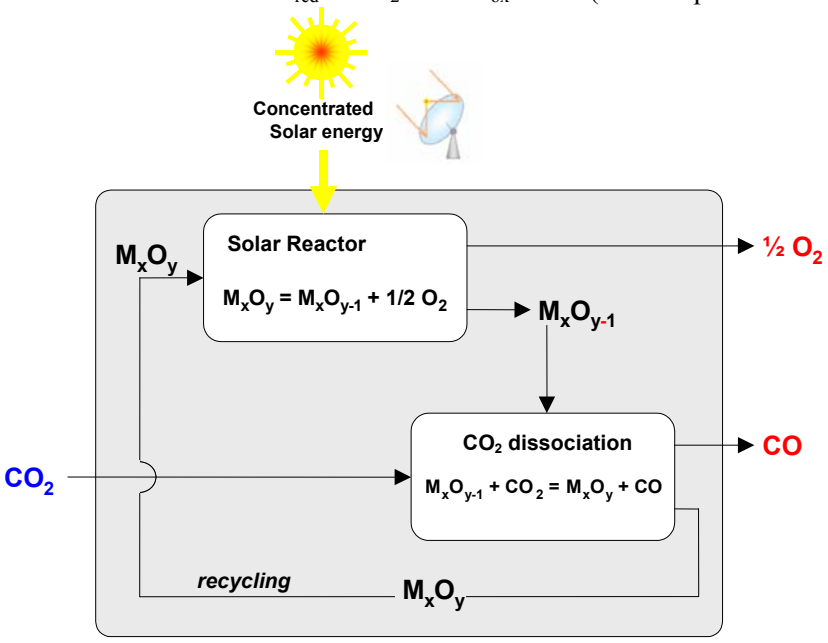

Fig. 1: principal of CO2 reduction by solar thermochemical processes.

As a result gas mixtures such as CO_2/H_2 and CO/H_2 may be produced by solar energy. Such mixtures are the reactants for liquid fuels production (solar fuels).

Keywords: concentrated solar energy, thermochemistry, thermochemical cycles, high temperature.