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Preparation and characterization of $Cu/ZnO/Al_2O_3$ catalyst for photothermal CO_2 conversion

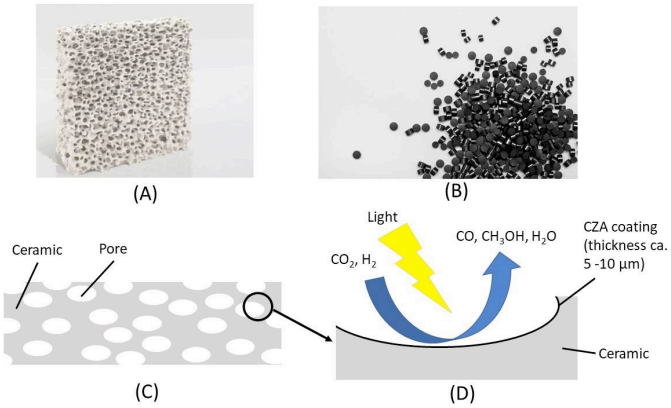

Figure 1: (A) Ceramic foam to be used as 3-D supporting structure; (B) Pellets of $Cu/ZnO/Al_2O_3$ (CZA) methanol synthesis catalyst; (C) Schematic of ceramic foam depicting the ceramic material and pores; (D) Detail of a pore with CZA coating driving the photothermal RWGS reaction.

The master thesis will be a cooperation between the Erlangen Center for Interface Research and Catalysis, led by Prof. Dr. M. Hartmann, and the group of Prof. Dr.-Ing. Ulrich Ulmer at the Technische Hochschule Nürnberg.

Photothermal catalysis exhibits potential advantages as compared to traditional heterogeneous catalysis and photochemical catalysis. Reaction rates can be increased, and product selectivity can be stimulated by opening photochemical pathways. The result is a significant reduction of the activation energy as compared to the reaction in the absence of light. $Cu/ZnO/Al_2O_3$ (CZA) catalysts, used on industrial scale for methanol synthesis, are also promising candidates for photo-thermal reversed water-gas-shift reaction (RWGS).

The master project is centred on the laboratory scale preparation, catalytic application, and analytic characterization of a CZA catalyst. The catalyst shall be prepared by either depositing commercial CZA catalysts or by depositing suitable sol-gel precursors on an alumina foam. Synthesis parameters will be optimized. The chemical surface structure will be investigated by various analytic characterization techniques, including infrared and solid-state NMR spectroscopy, while phase composition shall be studied by powder X-ray diffraction. *In situ* and *operando* analytic techniques (infrared spectroscopy, X-ray diffraction, UV-Vis spectroscopy, solid-state NMR spectroscopy) will give insight into the catalyst structure and behaviour under operating conditions. In parallel to the master project, the catalyst shall be investigated in a photothermal test stand at the Technische Hochschule Nürnberg.

We are looking for an independently working student (m/f/d) from chemical engineering or related courses of study. Preparation of the materials, catalytic testing and characterization techniques will cover around 30 % of the practical work each. A good working knowledge of English language is required. The thesis should be written in English. First possible starting date is July 1st 2023. If you are interested, please contact Dorothea Wisser (dorothea.wisser@fau.de) or Florian Wisser (florian.wisser@fau.de).