Mateusz Adam Baluk

New composites of modified TiO_2 NTs with nano-MOFs for photoconversion CO_2 to solar fuels

The most important challenges and goals of modern society are to find a new energy source to avoid the use of fossil fuels as well as to reduce the amount of greenhouse gases (e.g. CO_2). Heterogeneous photocatalysis is a promising technique that can meet the expectations. It is a green technology that can generate clean fuels: hydrogen from water and valuable hydrocarbons (CH_4, C_2H_6, C_2H_5OH, HCOOH, HCHO, CH_3COOH, etc.) from CO_2, synthesizing organic compounds. However, most of the materials that can be potentially used in the mentioned photocatalytic reactions require the use of expensive radiation in the UV range for their excitation and good performance. Therefore, it is necessary to find new photocatalysts that exhibit: **(i) high activity under visible range radiation, (ii) separation of electron-hole pairs after excitation (iii) efficient adsorption of CO_2 on the photocatalyst surface (for generating useful fuels by photoconversion of CO_2) and (iv) appropriate valence band (VB) and conduction band (CB) position of the semiconductor, (v) high photocatalytic stability.**

A new type of photocatalysts that meets the mentioned expectations can be the materials proposed in the project, which are new composites of modified TiO_2 NTs nanotubes with nano-metal-organic frameworks. The obtained material will be distinguished from other titanium dioxide based materials because it is a component with nano-MOFs between the nanotubes, which will be nanotubes still characterized by an open top morphology. Additionally, using suitable Ti-M alloys, (M=Cu, Ag) TiO_2 nanotubes modified with Ag_2O, Ag NPs or Cu_xO_y, Cu NPs will be obtained.

Modification of TiO_2 nanotubes with other semiconductors and nano-MOFs will provide high CO_2 sorption capacity which will be associated with increased efficiency of CO_2 photoconversion to useful fuels (methane, ethane, methanol, formaldehyde and others). The MOFs that will be sandwiched between the nanotubes will be able to serve various functions: as a **photocatalyst, cocatalyst, and as a charge separator and carbon dioxide sorbent.**

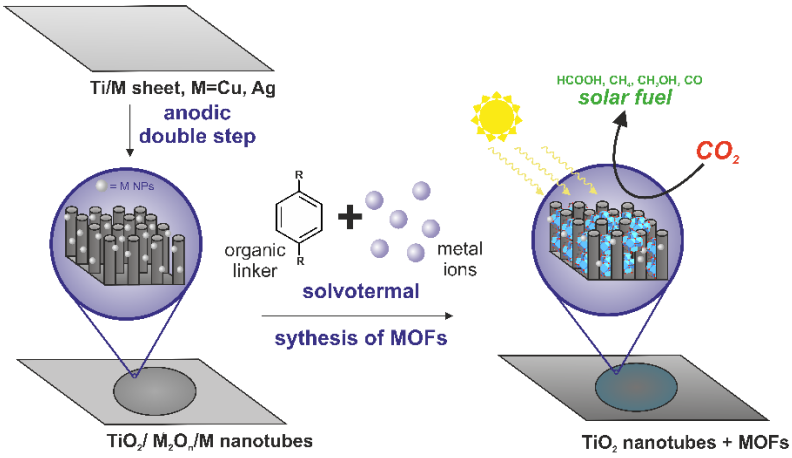

Fig. 1. Proposed uses of the component in photocatalytic reactions.