Development of catalytic materials systems for non-intermittent green hydrogen production

Motivation and Main Objective

A transformation in the production and use of materials and energy is required to fulfil the 2030 Agenda. This includes the need for efficient and cost-effective technologies to produce sustainable fuels, such as green hydrogen, as well as to treat environmental fuels and their waste. The production of green hydrogen via sunlight-driven photo-catalytic processes has the potential to solve some of these challenges, however, the adoption of this technology has its own scientific and technical challenges. One of the main challenges is the absence or intermittence of incident radiation (or in layman terms “amount of sunlight”), which induce fluctuations in the amount of produced fuel. A secondary, but equally important, challenge is the low applicability of already-researched photocatalytic systems. Currently, several studies aim at the synthesis of new compositions or improvement of commercial catalysts, thus focusing mostly on the materials science aspect. Nonetheless, there is also the need to consciously design and construct reactors for the catalysis process, so that the reactor can maximize the catalytic systems output product. Without the right reactor, the catalytic material performance might be hindered and thus, the fuel output. To address this, we founded CatMatSys, a binational network between German and Brazilian research institutions. This consortium will bridge materials science and chemical engineering point of views, to solve the challenges associated with the sustainable and efficient production of hydrogen, fostering the implementation of green hydrogen as a sustainable energy source in our society.

Methodology and Planned Activities

CatMatSys is a binational consortium between the Integrated Materials Systems group of the Hamburg University of Technology in Germany and the Laboratory of Mass Transfer and Numerical Simulation of Chemical Systems of the Federal University of Santa Catarina in Brazil. The three main objectives of our consortium is: I) The investigation of advanced ceramic-based material systems for non-intermittent catalysis (dark- + photo-catalysis). II) The design and development of a prototype reactor that maximizes the developed catalyst performance in regard to green hydrogen production efficiency. III) The strengthening of application-oriented Brazilian-German research cooperation between our institutions by the reciprocal training of early career researchers and ongoing work missions to develop joint work.

Intended Outcome

To effectively introduce hydrogen as a future fuel, it should be produced through efficient processes. CatMatSys aims at establishing guidelines for the next-generation processes for hydrogen generation by investigating, developing and using non-intermittent catalysts in its tailor-made optimized reactors. This will contribute to knowledge generation in terms of the fundamentals of non-intermittent catalysis, but also contribute to the initial development of functional prototypes that could allow scale-up and infer further industrial prospects. The Brazilian side will focus on the catalysts synthesis and composition development, while the German side will concentrate mainly on functionalization and catalytic material systems manufacturing; both institutions will construct analog reactor prototypes to assess and complement the application that will be carried out at both institutions, promoting the exchange of knowledge and the formation of people in this field.

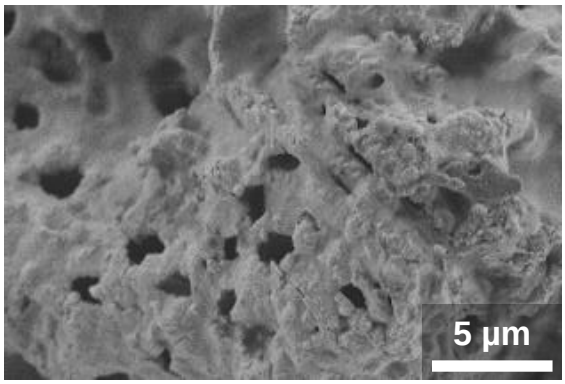

Figure 1. Scanning electron microscopy image of a nanostructured catalyst material system with multiscale porosity synthesized by the CatMatSys binational team.

German-Brazilian Cooperation

The ”German-Brazilian research cooperation in the energy sector - NoPa 2.0” is a Cooperation in the fields of green hydrogen/PtX, direct electrification and energy storage between the German Academic Exchange Service (DAAD) and the projects H2Brasil and E2Brasil. Both projects are part of the German-Brazilian Cooperation for Sustainable Development and are implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the Brazilian Ministry of Mines and Energy (MME) with funding from the German Federal Ministry for Economic Cooperation and Development (BMZ).

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