Institutul STAR-UBB vă invită la sesiunea științifică în data de 03.12.2020, cu titlul:

Tailoring the activity of photocatalysts: from hollow structures to shape-tailored nanoparticles

The synthesis of catalysts is a major issue nowadays in any research field, and especially in photocatalysis. The used nanomaterials should possess a structure which permits efficient charge carrier generation, but for that the light needs to be captured efficiently. For that purpose hollow structures are a perfect choice. Moreover, the nanoparticles' surface should also possess the necessary properties (crystal defects, surface OH groups, charge carrier separator crystallographic planes) to achieve the desired photocatalytic performance. The mentioned properties however are strongly dependent on the applied crystallization procedure (solvothermal crystallization and calcination).

14:00-14:05 – Opening words

14:05-14:50 – Prof. Dr Klára Hernádi, *University of Szeged*

„Fabrication of semiconductor hollow structures – advantages in photocatalysis”

14:50-15:35 – Dr. Zsolt Pap, *Babeș-Bolyai University*

*„**Calcination and solvothermal crystallization – tools to obtain TiO_2 the VIP photocatalyst**”*

Link Goggle Meet:

https://meet.google.com/vot-akxz-tnn

Fabrication of semiconductor hollow structures – advantages in photocatalysis

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Heterogeneous photocatalysis has recently emerged as one of the most effective and "greener" technique for the solution of certain environmental concerns. The photocatalytic activity of semiconductor materials can be dependent on various parameters such as the crystal phase composition, the crystallite size, the orientation of the crystal facets, structural hierarchy etc.

As it was demonstrated earlier[1], multiple reflections within a hollow cavity can lead to the enhanced utilization of the light source resulting in the production of more photogenerated charge carriers, thus increasing the photocatalytic efficiency of the semiconductor. Therefore, semiconductor hollow structures are of growing interest in the field of photocatalysis, too. These objects are interesting not just because of their unique optical properties but also their low apparent density. However, their reproducible fabrication can be challenging.

For the synthesis of either carbon-metal oxide composites or hollow semiconductor structures, nanometer sized carbon spheres (CS) were prepared by mild hydrothermal treatment of ordinary table sugar (sucrose). CSs were successfully coated with TiO_2 and ZnO via either sol-gel method or atomic layer deposition[2].

The unique hollow sphere morphology proved to enhance the photocatalytic activity (six times) as well as TOC removal efficiency (twelve times) compared to the reference sample. Combining the hollow spherical morphology with the deposition of noble metals, results revealed that both gold-deposited sample and platinum-deposited TiO_2-s showed higher photocatalytic activity in phenol or oxalic acid decomposition under UV light irradiation.

Calcination and solvothermal crystallization – tools to obtain TiO_2 the VIP photocatalyst

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To obtain any novel photocatalytic materials an efficient reproducible synthesis procedure should be developed. However, the cost of "rushing and jumping" into seemingly efficient and adequate solutions is extremely high and affects the scientific community by flooding the literature with inconsistent data. The most representative material is TiO_2 which is widely covered in the photocatalysis literature. There are numerous ways to obtain these materials including sol-gel based methods, solvothermal crystallization etc.

As the controlled crystallization requires energy it is very important to know the crystallization parameters, which can be differentiated based on the chosen crystallization procedure. When the calcination is the final step to obtain nanocrystalline titania, the time/duration, the calcination atmosphere and the heating rate of the furnace (for both muffle and tube furnaces) are those parameters which define the final properties of the material and some of them are systematically ignored (e.g. duration of the calcination), generating knowledge voids and misconceptions.

When a solvothermal crystallization is considered, the same parameters may be valid, however completed with the issues of crystallization media related chemistry, such as the acidity, polarity of the solvents, ionic strength, the presence of different shape-tailoring agents. Some of the simplest issue are also not quite considered here, namely the complex interaction of crystallization nuclei with the media, which may result in materials with complex structure and properties.

The two examples mentioned above are just a few drops in the ocean of scientific results and due to the rush to publish as soon as possible most of the appearing issues will remain unsolved, making the work of scientists harder later on.