Dye-sensitized 2D materials composites for photocatalytic hydrogen production

A. Lewandowska-Andralojc[1,2], J. Goscianska[1], , H. Garcia[3], B. Scheibe[4]
[1]Adam Mickiewicz University, Faculty of Chemistry, Uniwersytetu Poznanskiego 8, Poznan, PL
[2]AMU, Centre for Advanced Technology, Uniwersytetu Poznanskiego 10, Poznan, PL
[3]Instituto Universitario de Tecnología Química Consejo Superior de Investigaciones Científica and Departamento de Química, Universitat Politecnica de Valencia, Av. De los Naranjos s/n, Valencia 46022, Spain
[4]Nanobiomedical Centre, Adam Mickiewicz University, Wszechnicy Piastowskiej 3, Poznan, PL

alewand@amu.edu.pl

Photocatalysis is a an appealing strategy to exploit solar energy for fuel production. Innovative 2D materials with unique layered structures are expected to enhance photocatalytic activity due to excellent mobility of charge carriers and extremely high specific surface area.
In our work we explored the correlation between the photocatalytic activity and graphene oxide morphology (size and thickness) [1]. Our results clearly demonstrated that both size and thickness of GO flakes do matter for the photocatalytic hydrogen production. Subsequently by integrating two types of functional materials: graphene oxide and Co-MOF we designed a stable system with enhanced charge-separation properties which ultimately boost their photocatalytic activity. The activity of our Co-BDC in the presence of graphene oxide was found to be remarkable (33,300 µmol g^{-1} h^{-1} per gram of MOF) in comparison to other MOF systems (Fig. 1) [2].

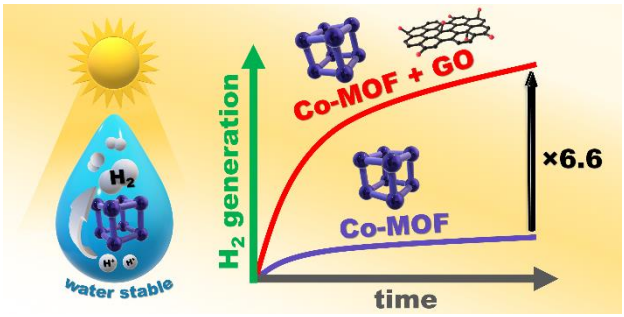

Figure 1. Boosting photocatalytic hydrogen generation by integrating Co-MOF and graphene oxide.

Recently we explored the hydrogen production by functionalizing non-covalently eosin Y to $Ti_3C_2T_x$ or Nb_2C. For example it was found that a Nb_2C sample obtained by chemical etching and 4 h sonication (Nb_2C-4h) with a high specific surface area in aqueous suspension of 161 m^2 g^{-1} showed the highest hydrogen generation rate (10,290 µmol $h^{-1}g^{-1}$), 3.2 times higher than that of Nb_2C obtained by chemical etching without post-synthetic sonication that has 55 m^2 g^{-1} of specific surface area in suspension. The increased performance of Nb_2C-4h surpassing many reported photocatalysts was attributed to the beneficial influence of the exposed surface area and level of exfoliation of the MXene sheets [3].

Acknowledgments: This work was supported by AMU “Excellence Initiative - Research University" (grant number: 038/04/NS/0012)

References

[1] E. Gacka, L. Majchrzycki, B. Marciniak, A. Lewandowska-Andralojc, Sci. Rep., 11, (2021), 15969
[2] A. Ejsmont, A. Lewandowska-Andralojc, K. Hauza, J. Goscianska Int. J. Hyd. Energy, 48, (2023), 8965
[3] R.R. Grau, A. Lewandowska-Andralojc, A. Primo, H. Garcia, Int J. Hyd. Energy, (2023) accepted