Novel nanohybrids: dye/graphene-based material of potential use in photocatalysis

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By functionalizing non-covalently dye molecules (porphyrins, xanthenes) to graphene-basec material (GO or RGO) , we obtained novel nanomaterials with potential application in photocatalytic hydrogen production. In our work we synthesized and thoroughly characterized dye-GO and dye-RGO nanohybrids. Results of FTIR, Raman spectroscopy, thermogravimetric analysis (TGA), atomic force microscopy (AFM) and elemental analysis have confirmed successful non-covalent functionalization of graphene sheets with porphyrins.[1-2] Ultrafast time-resolved transient absorption spectroscopy clearly demonstrated the occurrence of electron transfer from the photoexcited porphyrin to GO, indicated by very fast decay of the excited state and the formation of a porphyrin radical cation [2]. These results are relevant to the use of such systems in developing energy conversion assemblies.
Under visible irradiation noble-metal-free system EY-RGO-Co(bpy)$_3^{2+}$ demonstrated higher photocatalytic activity than EY-Co(bpy)$_3^{2+}$. RGO material acts as an acceptor and mediator of the electrons. The recombination of photoexcited charges is greatly retarded, and the photocatalytic activity increases.

References

[1] Gacka E., Wojcik A, Mazurkiewicz-Pawlicka M, Malolepszy A., Stobinski L., Kubas A., Hug G.L., Marciniak B., Lewandowska-Andralojc A., J. Phys. Chem. C, 123, 2019, 3368
[2] Larowska D., Wojcik A, Mazurkiewicz-Pawlicka M, Malolepszy A., Stobinski L., Marciniak B., Lewandowska-Andralojc A., ChemPhysChem, 20, 2019, 1054

Figures

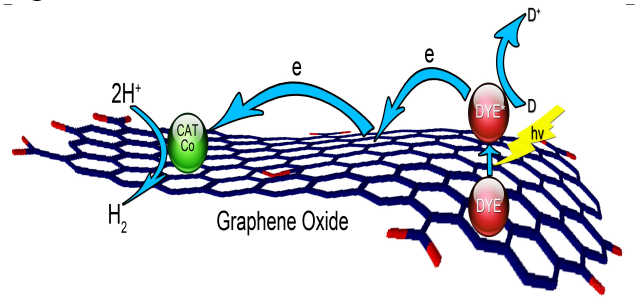

Figure 1: Schematic hydrogen evolution over dye/graphene oxide/Co cat. under visible light irradiation; D – sacrificial electron donor.

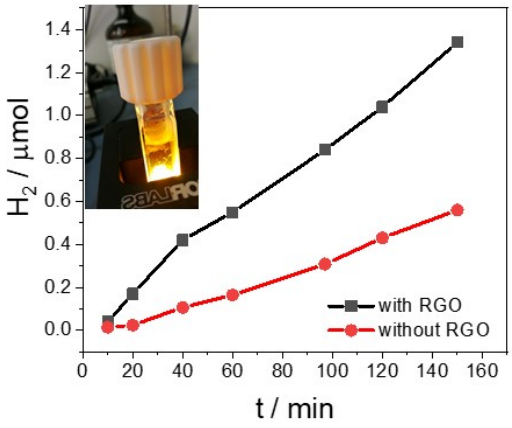

Figure 2: The amount of H_2 evolved under visible light irradiation: EY-RGO-Co(bpy)$_3^{2+}$ (black), EY-Co(bpy)$_3^{2+}$ (red). Reaction conditions: [EY] = 0.4 mM, [Co(bpy)$_3^{2+}$] = 45 µM [RGO] = 1.3 x 10^{-3} mg ml^{-1} [TEOA] 5 vol%, pH = 10.2,

Funding: This work was supported by the National Science Centre (Grant Number: 2015/19/D/ST5/00682).