The surface chemistry of graphene oxide: Enhancing the performance of ZnO – GO photocatalysts

S. Victor-Román[1], E. García-Bordejé[1], J. Hernández-Ferrer[1], J.M. González-Domínguez[1], A. Ansón-Casaos[1], A.M.T. Silva[2], W.K. Maser[1], A.M. Benito[1]
[1]Instituto de Carboquímica (ICB-CSIC), C/Miguel Luesma Castán 4, 50018 Zaragoza, Spain
[2] LSRE-LCM, Faculdade de Engenharia, Universidade do Porto, 4200-465 Porto, Portugal

abenito@icb.csic.es

We demonstrate that the surface chemistry of graphene oxide Graphene oxide (GO) is of critical importance for the photocatalytic performance of semiconducting metal oxides such as TiO_2 or ZnO. To this end we employ GO with distinct and well-defined oxidation degree for the preparation of ZnO-GO hybrid materials. We show that the surface chemistry of GO is key for facilitating favorable interface interactions. This results in a lowering of the alignment of energy levels at the ZnO-GO interface and enables the transfer of photo-excited electrons from ZnO to GO. The remaining positive charge at the valence band of ZnO then easily can promote oxidation reactions with the analyte and/or the solvent. In this way, GO reduces the recombination rate of the photogenerated electron-hole pair and enhances the photocatalytic activity of ZnO. We show that by solely controlling the oxidation degree of GO and by optimizing the loading fraction highly efficient ZnO-GO photocatalysts can be prepared. Most favorable conditions are achieved for intermediate oxidation degrees of GO. Optimized ZnO-GO hybrids thus reveal photocatalytic degradation of methylene blue at conversion rates of up to 80%, within times as short as 70 minutes at concentrations as low as 0.045 mg/mL, accompanied by a good recyclability behavior. The results are of general character and extendable to semiconducting metal oxides used in photocatalysis [1].

References

1. S. Victor-Román, E. García-Bordejé, J. Hernández-Ferrer, J.M. González-Domínguez, A. Ansón-Casaos, A.M.T. Silva, W.K. Maser, A.M. Benito, Catalysis Today 2019. DOI: 10.1016/j.cattod.2019.05.049

Acknowledgements: Spanish MINEICO (Project ENE2016-79282-C5-1-R, AEI/FEDER, UE and FPI Grant BES2014-068727) and Government of Aragon (DGA-T03-17R, FEDER, UE), is gratefully acknowledged.