

Hybrid Nickel-free graphene polyporphyrin photocatalyst: Time-saving formulation and photodegradation studies

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The design of graphene-based (G) hybrid nanomaterials for photocatalytic applications is one of the most promising routes in the field of water remediation. The combination of G with photoactive materials strongly improves the photocatalytic activity by boosting the separation and transfer of photo-generated charges, which drastically affects the photocatalytic performances. As it turns out, organic photosensitizers, which have an excellent visible-light (VL) activity, coupled with the charge transfer properties of G materials represent cutting-edge water treatment technology. In this work, hybrid nanocomposites were realized by combining high-quality 3D graphene and photoactive porphyrins [1]. First, graphene was grown on Ni foam by Chemical Vapor Deposition, and characterized by Raman spectroscopy. Then, cyclic homo- and co-polyporphyrins were deposited onto 3D graphene by spin-coating and a time-saving nickel-etching procedure has been developed preserving the graphene 3D network. The samples were morphologically characterized by SEM and AFM analyses and, finally, methylene blue photodegradation and recyclability tests were carried out by using only 0.4 mg of photoactive material, showing outstanding performances. The sterically hindered cyclic poly-porphyrins increased the number of photoactive sites, limiting the formation of agglomerates, and thus improving the charge transfer process onto the graphene. Moreover, the polymer coating protects graphene from the direct exposure to light, dyes and OH• radicals, which drastically reduce the

photocatalytic efficiencies. The higher activity of the copolymer was attributed to: (i) the presence of secluded porphyrins along the cyclic chains and (ii) the higher molecular weight than homopolymer. These results open the route for VL water treatment technologies based on innovative hybrid nanomaterials through a direct and extensive contact between the G and the photosensitizer polymers via non-covalent interactions.

[1] Ussia M. et al, Sci. Rep., 2018, 8:5001