Title:	Role of interfacial contact between 2D materials and preselected nanostructures in the degradation of toxic dyes: Multifunctional facets of graphene
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Abstract:	Designing intimate interfacial contact between nanostructures and two-dimensional (2D) materials is highly desirable to influence the movement of generated charge carriers. Nanostructured zinc oxide (ZnO) is a fascinating material with unique optical and electrical properties. 2D reduced graphene oxide (rGO) exhibits semiconductor behaviour with tunable catalytic activity and excellent biocompatibility. Hence, we have designed a hybrid material by selecting nanostructures of an oxide semiconductor (ZnO) with reduced graphene oxide (rGO) using a hard integration technique followed by a low-temperature hydrothermal route. The good encapsulation of rGO over the ZnO nanorods was confirmed by powder X-ray diffraction, scanning electron microscopy, transmission electron microscopy, Fourier transform infrared spectroscopy, and Raman spectroscopy. The photocatalytic activities of ZnO, rGO, and ZnO/rGO were studied under visible-light irradiation using three different toxic dyes, methylene blue (MB), methyl orange (MO), and Congo red (CR). The composite materials exhibited excellent efficiencies of 100, 95, and 90% for the degradation of MB, MO, and CR, respectively. Moreover, the degradation of the dye was found to follow first-order kinetics. The enhanced efficiencies are attributed to the adsorption and efficient charge transfer from rGO to the conduction band of ZnO. The role of the multifunctional facets of graphene was presented to elucidate the visible-light activity of the composite materials for enhanced efficiency. The main reactive species (e−) of the reduction reaction were confirmed through a radical trapping experiment, which showed the generation of highly reactive •OH radicals that decompose the toxic dye. The results provide a perspective for developing graphene-based composite materials with desired preselected nanostructures for solar energy utilisation.
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