Facet-Engineered $Bi_2Ti_4O_{12}$ Nanosheets Coupled with rGO: Interfacial Charge Transfer via Controlled GO Photoreduction.

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Abstract

Graphene-based semiconductor hybrids have emerged as powerful platforms for interfacial charge engineering, enabling enhanced carrier separation and transport in multifunctional energy materials [1-4]. In this work, facet-oriented $Bi_2Ti_4O_{12}$ (**BiTi**) nanosheets with preferential (001) exposure were coupled with reduced graphene oxide (**rGO**) via a controlled in situ photoreduction strategy. This method enables simultaneous reduction of graphene oxide (GO) and formation of intimate semiconductor/graphene interfaces, promoting strong electronic coupling and efficient charge-transfer pathways.
The progressive restoration of the sp^2-conjugated carbon network during photoreduction enhances the electrical conductivity of the graphene phase and optimises interfacial electronic interactions. Structural and spectroscopic analyses confirm successful hybrid formation while preventing the facet-engineered morphology of BiTi. Electrochemical impedance spectroscopy (EIS) reveals a marked reduction in charge-transfer resistance for BiTi/rGO composites compared to pristine BiTi, demonstrating accelerated carrier mobility and supressed recombination, consistent with established graphene-mediated electron extraction mechanisms [2,3].
The synergistic combination of crystallographic facet control and graphene-enabled interfacial transport results in improved photoinduced charge separation and enhanced functional response. Such engineered hybrid architectures hold strong potential for piezoelectric energy harvesting, photoelectrochemical conversion, and broader multifunctional energy applications. This study underscores the central role of graphene chemistry and interface design in tailoring charge dynamics in advanced hybrid materials.

References

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