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Effect of different climate zone's humic and fulvic acid on aggregation of UV irradiated graphene oxide

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Aims and scope

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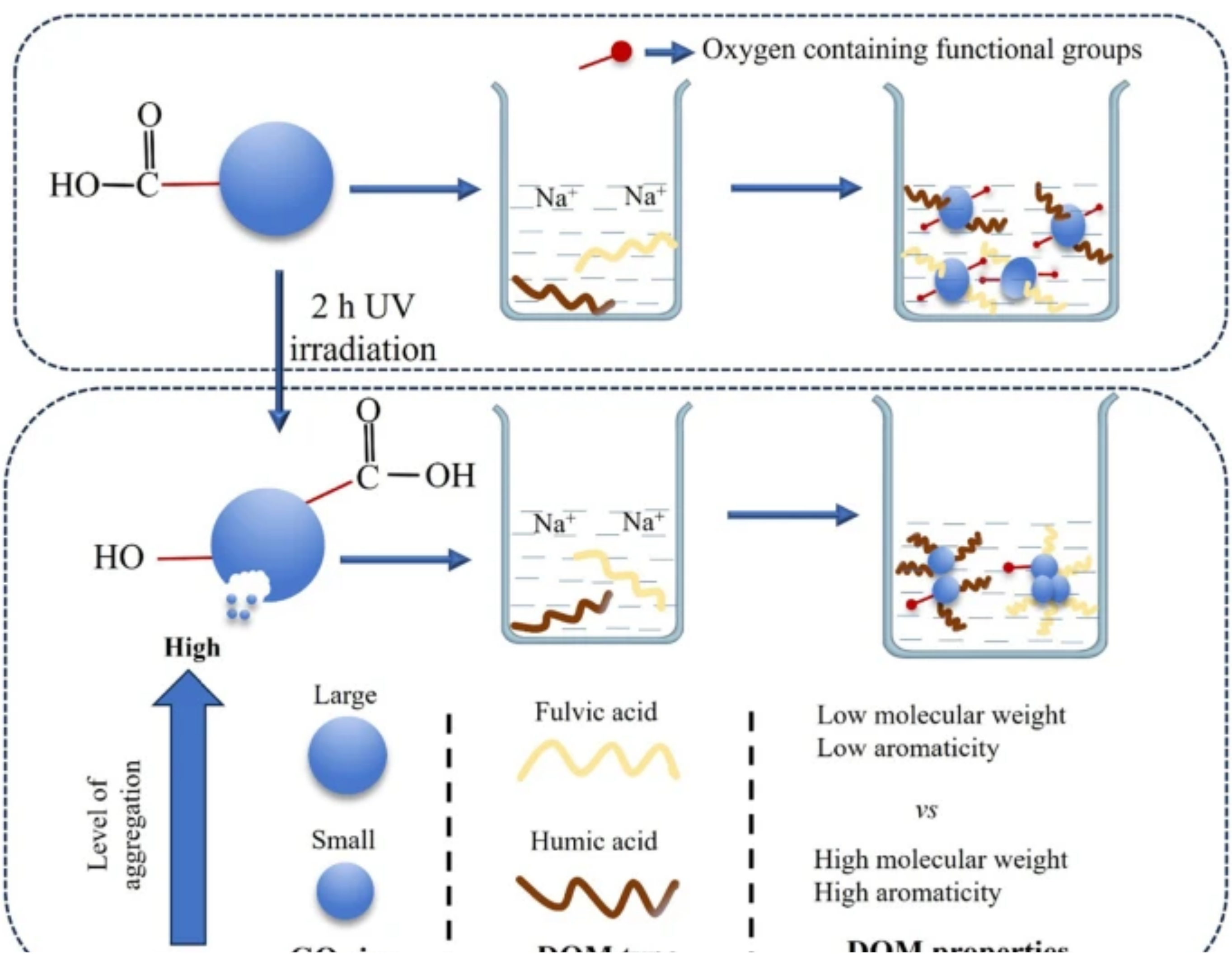
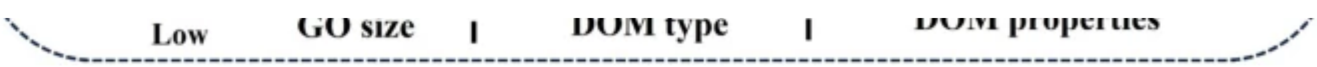
Abstract

UV light absorption by aquatic systems affect the physicochemical characteristics of graphene oxide (GO) nanoparticles which ultimately influence its aggregation behavior in water. Regarding this research, various humic and fulvic acids (HA/FA), extracted from China's different climate zones, were treated with 2 h UV irradiated large (~500 nm) and (~200 nm) GO in 200 mmol/L NaCl. UV irradiated GO particles displayed aggregation even at

low humic acid/fulvic acid (HA/FA) concentrations ranging from 0.2 to 1.0 mgC/L, whereas pristine GO particles did not exhibit such behavior. Reduction of functional groups, containing Oxygen (C=O/C–O), via UV irradiation is responsible for this aggregation phenomenon and conversion of GO to reduced graphene oxide (rGO). Consequently, rGO exhibits lower dispersibility, facilitating its agglomeration. Moreover, both small and large-sized GO particles exhibited less aggregation in HAs compared to FAs due to large molecular weight and high polarity of HAs. Aggregation of GO was more obvious with Makou FA and Maqin HA from Plateau and Mountain climate zone and Subtropical Monsoon climate zone, respectively, owing to DOM's lower molecular weight and aromaticity that reduced their adsorption. The application of the Derjaguin-landau-verwey-overbeek (DLVO) theory did not reveal any significant interaction energy barrier between the 2 h UV irradiated GO particles even in the presence of DOM, indicating that aggregation prevailed despite the addition of DOM. These findings highlight that UV irradiation poses a significant threat to the GO stability in aquatic environments, particularly in the presence of DOM.




Low
GO size
DOM type

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Ethics declarations

Conflict Interests The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Additional information

Highlights

- GO converted to rGO with less hydrophilicity after 2 h UV irradiation.
- UV irradiated GO aggregated more with different climate zone's FA than HA.
- Physicochemical properties of HA/FA had obvious effect on UV-aged GO aggregation.
- C–C/C=C and C–O functional groups involved in GO's stability/aggregation.

Supporting Information for

Effect of different climate zone's humic and fulvic acid on aggregation of UV irradiated graphene oxide

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