The challenge of "Forever chemicals": capture of perfluorinated pollutants in water using 2D composites.

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Per- and polyfluoroalkyl substances (PFAS) are commonly referred to as 'forever chemicals' due to their persistence in both the environment and human bodies, as well as their proven ecological and human toxicity. The extreme resistance of PFAS to degradation is due to the strength of the C-F bond, which is the strongest single bond in organic chemistry and its strong electron-withdrawing effect that strengthens the skeletal bonds in the carbon chain. PFAS are widely used in industrial products such as food packaging, non-stick cookware, paints, waterproof clothing, stain repellent, cosmetics, and firefighting foams.
PFAS occurrence in drinking water has been reported in several countries. For example, in the Italian Northern region of Veneto and in southern Sweden, residents have shown PFAS blood levels 100 times higher than the reference group.
In recent years, we have produced and tested novel composites that incorporate 2D materials, specifically Graphene Oxide (GO), and combined them with commercial filters to effectively remove water contaminants, including PFAS. The adsorption of perfluoroalkyl substances (PFAS) with a chain size greater than 5 carbon atoms on GO nanosheets is primarily due to van der Waals interactions, which are dependent on hydrophobicity. For short-chain PFAS, such as PFBA, the adsorption capacity of GO is lowered due to the negative charges of both PFAS and GO overcoming hydrophobic interactions. GO-polymer composites for water purification are currently being tested in a pilot plant by one of our industrial partners on the Po river in Italy.

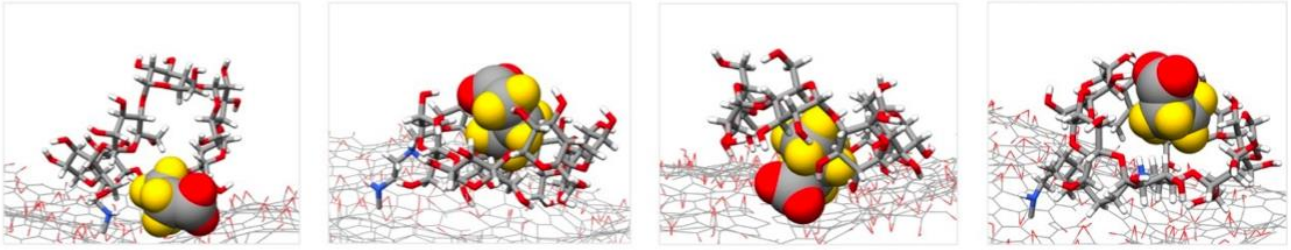

Figure 1: Simulation of the capture mechanism of PFAS using GO functionalized with cyclodextrins.

References

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