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## Photocatalytic removal of perfluoroalkyl substances from water and wastewater conducted by nanomaterials of $TiO_2$, $Ga_2O_3$ and $In_2O_3$

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A variety of heterogeneous photocatalysis technologies to effectively decompose perfluoroalkyl substances (PFAS) have been reported, which are of worldwide concern as emerging persistent organic contaminants. Heterogeneous photocatalysis is an effective and advanced technology for PFAS removal from water with relatively high efficacy. During photocatalysis, various short chain perfluorocarboxylic acids (PFCA) are produced as intermediates and the efficacy is related to the photo-generated hole ($h^+$) and photo-generated electron ($e^-$). PFAS photodegradation in water under UV irradiation is most effective by using $In_2O_3$ as the catalyst, followed by $Ga_2O_3$ and $TiO_2$. Significantly, modifying the chemical composition or morphology of the catalysts can improve its efficacy for PFAS removal. $In_2O_3$ porous nanoplates were found to have the best performance of 100% PFAS decomposition under UV light with rate constant and half-time of 0.158 min−1 and 4.4 min, respectively. In addition, catalysts perform well in acidic solution and increasing temperature to a certain extent. The photocatalytic performance is reduced when treating wastewater due to the presence of dissolved organic matter (DOM), with the catalysts following the order: needle-like $Ga_2O_3$ > $In_2O_3$ > $TiO_2$. Further research is needed to speed up the application of photocatalysis in degrading PFAS from wastewater at industry scale.

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