Advanced Materials and Strategies for Emerging Contaminants in Water Remediation

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Water pollution is one of the most relevant environmental problems and one of humankind's most considerable challenges. The World Health Organisation estimates that around 842,000 people die yearly from contaminated water consumption. The most pressing issues result from the contaminants of emerging concern (CEC), such as pharmaceuticals, due to their persistence on water bodies, endangering aquatic organisms and humans.

In this context, advanced materials for remediating and monitoring those contaminants' environmental impact are urgently necessary. This presentation showcases the development of broad-spectrum multifunctional membranes based on synthetic and natural polymers using different processing techniques, such as solvent casting and additive manufacturing approaches. Loading these membranes with active materials such as titanium dioxide (TiO_2), Zeolites, and metal-organic frameworks (MOF) allows them to address environmental issues with specific and tailored remediation principles and strategies. Thus, photocatalytic membranes based on Poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP) are used to degrade organic contaminants (e.g., antibiotics), and sorbent membranes relying on PVDF-HFP and chitosan are used to remove heavy metals (e.g., chromium) from different water matrixes, including wastewater treated effluents. Finally, in the sustainability and circular economy scope, membranes reusability, ecotoxicity and their second life (another application) are evaluated.