Peculiar membranes for efficient removal of microplastics from water

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Abstract: Microplastics (MPs) are plastic particles smaller than 5 mm that can originate from both aquatic and land-based sources. The irreparable damages that MPs and their fragmented nanoplastics inflict on human health and the environment are recognised and undeniable. While the occurrence and fate of MPs in the environment and treatment facilities have been recently studied, no targeted treatment techniques have been identified or developed to efficiently remove MPs from water streams. Wastewater treatment plants (WWTPs) are one of the main pathways by which MPs enter the aquatic environment, accounting for over 25% of total MPs entrance into the oceans. MPs cause pollution, disrupt carbon sequestration in the seafloor and infiltrate animal and human tissues via water consumption. Current treatment technologies in desalination and WWTPs have not been designed to effectively capture/remove MPs from the water. Although membrane filtration processes can offer effective solutions for MP removal, limited research has been devoted specifically to the application of polymeric membranes for MP treatment in the water industry. The purpose of this work is to overview some membrane modification strategies that have been recently conducted by my team to fabricate advanced functional membranes and tailor their physicochemical properties for more efficient MP removal and enhanced fouling mitigation. Figure 2 shows a schematic illustration of a nanoparticle integration approach as an exemplar of the membrane structure-property modification together with the relevant cross-section TEM image of the nanocomposite membrane.

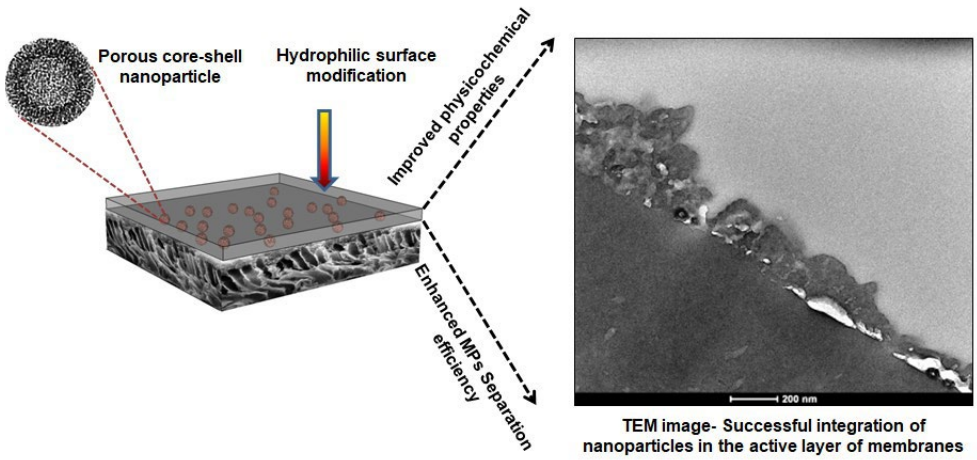

Figure 1. Exemplar of a membrane structure-property modification

The developed membranes will be later integrated with other treatment techniques to provide multifaceted MP separation. The expected outcomes include advanced membranes with high separation and antifouling resistance to MPs. This will have significant benefits, including the efficient removal of MPs from water sources securing cleaner potable, irrigation and recycled water, and contributing to a safer, healthier environment.

Keywords: Microplastics, Polymeric membranes, Fouling mitigation, membrane modification