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EDITORIAL

Special issue on “Membranes and Water Treatment”

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Water scarcity is becoming the greatest global crisis of our time. The increasing demand for clean and safe water calls for intensive research on advanced water treatment technologies. Recent decades have witnessed the rapid development of membrane technology, which are competitive for water and wastewater treatment, and encouragingly, some of them have been commercialized nowadays. The advances in material science have substantially promoted the further development of membranes technology in the aspects of membrane materials, membrane microstructure and fabrication process. Great efforts are thus being devoted to exploring the potential of new materials and processes for advanced membranes, as well as their integration with other processes, aiming at overcoming the longstanding challenges in membrane separation, removing emerging pollutants, and achieving high-value utilization of wastewater.

This special issue is a collection of 7 original research papers and 6 reviews on advanced membranes and membrane processes for water and wastewater treatment, including nanofiltration (NF) membranes, membrane distillation (MD), pervaporation (PV) membranes, reverse osmosis (RO) membrane and forward osmosis (FO) membranes, catalytic ozonation membrane (COM) reactor, membrane bioreactors (MBRs) and bipolar membrane electrodialysis (BMED), with emphasizes on advanced membrane fabrication and specific wastewater treatment technologies.

First, the design and modification of membrane materials become significantly essential. For example, Goh et al. reviewed the recent development of chlorine resistant of polyamide (PA) thin film composite (TFC) membranes, including the membrane material optimization and surface modifications by *in situ* and post-treatment approaches [1]. Zhang et al. proposed an ionic strength directed self-assembly procedure for the preparation of low-pressure NF membranes consisting of only a single bilayer of poly(diallyldimethylammoniumchloride) and poly(sodium-4-styrenesulfoate) [2]. Bai et al. developed a superior alkali-resistant PV membrane for alkaline wastewater treatment, by means of depositing a glutaraldehyde crosslinked sodium carboxymethylcellulose layer on a polyethylene microfiltration membrane [3]. Based on the advances in membrane materials, Capizzano et al. systematically summarized the recent developments in the field of MD, with interests in the related patents and the innovation in membrane materials. In addition, the nature of materials used in the membrane fabrication also determines the sustainability of the preparation processing [4]. For example, Pan et al. used tributyl citrate (ATBC) as a nontoxic and environmentally safe diluent to prepare poly(vinylidene fluoride)-co-hexafluoropropylene (PVDF-HFP) membranes via thermally induced phase separation (TIPS) [5].

Second, functional design of membranes with emerging nanomaterials in membrane matrix provides unprecedented opportunities to precisely tune the microstructure of separation membranes. For example, Xu et al. constructed two-dimensional (2D) MnO_2-incorporated ceramic membrane with the interspacing tuned by carbon nanotubes (CNTs), which were used as catalytic ozonation membrane (COM) reactor for degrading methylene blue (MB) in wastewater [6]. Zhang et al. prepared highly permeable polysulfone-b-poly(ethylene glycol) ultrafiltration membranes with the combined strategies of selective swelling and sacrificing nanofillers [7]. Yang et al. critically reviewed these modification approaches of poly (aryl sulfone) membranes for improved hydrophilicity and clarified the effects of various modification methods on the separation performance, antifouling properties, and long-term durability in water treatment [8].

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Third, due to the diversity of water and wastewater, it is worthy of purposely designing the membrane and membrane processes, particularly for removing the emerging pollutants. The concept of fit-for-purpose of membrane technology for emerging wastewater has recently gained increasing attention. For instance, in response to the current global pandemic (COVID-19), Zhao et al. summarized the main pollutants in common hospital wastewater and pointed out the potential contribution of hybrid MBRs and integrated MBR-membrane systems toward the hospital wastewater treatment [9]. Besides, Chen and Ge developed a new class of draw solute for forward osmosis (FO) to treat the Li^+-containing wastewater from LIB industry [10]. The application of forward osmosis (FO) technology for various wastewater treatment has been reviewed by Zhu et al., where fouling control strategies were summarized based on a thorough discussion about the membrane fouling types and fouling mechanisms [11]. In addition, Guo et al. comprehensively reviewed the latest progress of NF-based drinking water treatment in various scenarios. Beyond water reuse, hybrid membrane technology for high-value utilization of wastewater is a promising and rising direction [12]. As a representative example, Hussain et al. developed a bipolar membrane electrodialysis (BMED) process for highly concentrated base production from high-salinity wastewater [13].

With these valuable contributions, we hope that this special topic issue will be inspirational to researchers who are interested in advanced membranes and their related applications in water and wastewater treatment.

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