



Membranes

an Open Access Journal by MDPI

CiteScore: 9.4

Indexed in PubMed

Impact Factor: 4.2

Special Issue Reprint

Modeling and Simulation of Industrial and Environmental Processes with Membranes

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This Reprint focuses on recent advances in modeling and simulation applied to membrane processes and membrane-based systems. Modeling and simulation are efficient tools for understanding transport phenomena, designing membrane units, optimizing process performance, and integrating membrane technologies into larger chemical and environmental systems. Membrane processes are better described by considering rate-based transport mechanisms, and they involve complex interactions among membrane materials, hydrodynamics, operating conditions, and physicochemical phenomena such as fouling and scaling. All these features make the modelling of membrane processes more challenging. The contributions collected in this Special Issue illustrate the wide range of modeling approaches currently used in membrane science and engineering. These approaches span multiple scales, from microscopic descriptions of membrane materials and transport mechanisms to module-scale hydrodynamics and system-level process simulation and optimization. Attention is also given to modelling hybrid processes in which the membrane interacts with other unit operations. The articles include studies on the modelling of transport and physicochemical effects influencing membrane performance, filtration, desalination, environmental and system-level simulations, and the use of artificial intelligence. Together, these contributions provide a comprehensive overview of current modeling strategies, including artificial intelligence, and demonstrate the growing importance of simulation tools for membrane development and the deployment of membrane processes.



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