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PREFACE

Editorial

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Preface to the Special Issue "Track-Etched Membranes: Future Prospects, Opportunities and Challenges"

Track-etched membranes (TeMs) represent a unique class of materials whose precise pore geometry and adaptable surface chemistry have made them indispensable in many areas of modern science and technology. Originally developed as filters for biological and analytical applications, they are now widely recognized as versatile functional platforms in separation processes, energy devices, sensors, and biomedical technologies. Their ability to combine reproducible nanoscale structure with tunable chemical modification explains the sustained interest in this field and provides the motivation for this Special Issue.

The present volume brings together contributions that reflect both the maturity of TeM research and the ongoing search for new directions. It includes **two review articles**. The first offers a concise overview of the potential of TeMs in sensor development, highlighting how controlled pore structures can be integrated into devices for highly sensitive detection. The second review, prepared within the framework of an international collaboration, discusses the progress in functionalized composite and hybrid membranes, emphasizing the role of TeMs as reliable supports for advanced materials. Together, these articles provide context and perspective for the original works presented in this collection.

A central part of this Special Issue is devoted to the **modification and development of new types of TeMs**. The papers in this section describe radiation-induced pore-confined grafting of PVDF membranes, graft polymerization of long-chain acrylates on PET membranes for distillation applications, and the preparation of cation-exchange membranes by pore filling with perfluorosulfonic acid polymers. Other contributions examine the functionalization of PET membranes with amine-containing polymers. These studies collectively illustrate the wide range of strategies now available for tailoring TeMs at the nanoscale, with direct implications for transport behavior and selectivity.

The collection also includes contributions under the theme of **prospective applications**. Here, the use of TeMs is explored in fields that extend well beyond their traditional role in filtration. Examples include the design of membranes for X-ray and vacuum ultraviolet optics, studies of the biological compatibility of PET membranes in cell culture systems, and the use of TeMs as substrates for surface-enhanced Raman scattering (SERS) with gold nanowires. These works underscore the breadth of application spaces where TeMs are proving to be effective and reliable.

A further group of papers focuses on **TeM-based composites**. These include the immobilization of nickel-based metal–organic frameworks on modified TeMs for dye removal, the preparation of copper–silver composite catalysts supported on TeMs for electrochemical reduction processes, and comparative studies of SERS effects on composite membranes with silver nanostructures obtained by different fabrication routes.

Such examples highlight how the intrinsic structure of TeMs can be combined with functional materials to generate composites with enhanced catalytic and sensing properties.

Taken together, the contributions in this Special Issue document the steady progress of TeM research, from methodological advances in membrane modification to the demonstration of new applications in diverse areas. They also reflect the collaborative and international nature of the field, with studies carried out by research groups from various countries, such as Kazakhstan, Russia, South Africa, and Türkiye.

It is a privilege to present this Special Issue to the scientific community. We hope that the collection of articles will be of value to researchers working with membranes, nanostructured materials, and applied technologies, and that it will serve as a reliable source of current knowledge in this dynamic and interdisciplinary area.

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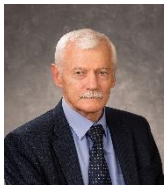

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