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The special issue titled "MXene Chemistry and Applications" in *Small Methods* covers invited contributions from the leading scientists in the field of the rapidly expanding category of two-dimensional transition metal carbides/nitrides known as MXenes. This special issue features research papers and review articles that cover the whole field of MXenes, from their synthesis and chemistry to their applications in various research fields.

The review contribution by He Seok Park et al. (smtd.202201440) offers an overview of the electrochemical storage of anions in MXenes, which is an emerging field. Additionally, Xuehang Wang et al. (smtd.202201683) present a review focusing on energy storage applications in aqueous zinc-ion batteries. Shubin Yang et al. (smtd.202201559) explore the current state of MXene derivatization to improve the performance in various types of energy storage applications. In another review contribution, Zhong-Shuai Wu et al. (smtd.202201609) discuss the current status of high-voltage supercapacitors based on MXene materials. The ability to operate within a high potential window, typically exceeding 3 V, is crucial for their practical applications. George Zheng Chen et al. (smtd.202201724) provide a focused review of electrochemical processes in supercapacitors, their degradation mechanisms, and new directions for improving cycling stability and other parameters. Addressing a different aspect, Pool See Lee et al. (smtd.202300077) discuss the rapidly growing direction of MXene applications in heat management, heat dissipation, Joule heating, and thermoelectric and photothermal conversions. The review article by Yang Huang et al. (smtd.202300190) summarizes the new developments of MXenes in thermocells based on the thermogalvanic effect for energy harvesting. Furthermore, Joselito M. Razal et al. (smtd.202201527) provide an excellent overview of various X-ray-based methods for the chemical and structural characterization of MXene. The review contribution by Xu Xiao et al. (smtd.202201530) explores the current understanding of the surface and interface chemistry of MXene, which is crucial for their applications in almost every field of use.

The experimental research articles published in this special issue cover various aspects of MXenes, including synthesis, chemistry, and diverse applications. Agnieszka Maria Jastrzębska et al. (smtd.202201252) present the applications of oxidation-modified MXene for photocatalytic degradation of various dyes, including industrial waste products. Bahareh Khezri et al. (smtd.202201547) demonstrate the use of MXenes in the fabrication of artificial microrobots for the photocatalytic decomposition of Bisphenol A, resulting in the production of carbon dioxide and water. Artur Ciesielski et al. (smtd.202201651) focus on controlling the surface chemistry of Ti_3C_2 MXene through APTES-based functionalization, leading to the fabrication of humidity sensors with excellent detection linearity.

Flavia Vitale et al. (smtd.202201318) showcase the biomedical applications of MXenes in non-invasive muscle monitoring for disease and rehabilitation monitoring. Chong Min Koo et al. (smtd.202201579) report the synthesis of halogen-free MXene using a hydroxide-based exfoliation reagent. This halogen-free MXene exhibits improved biocompatibility with living cells and eliminates its cytotoxicity. Sanjiv Dhingra et al. (smtd.202300044) demonstrate the antiviral properties of MXene quantum dots against COVID, showcasing its potential bioapplications. Lucia Gemma Delogu et al. (smtd.202300197) present a novel biomedical platform utilizing V_4C_3 MXene and explore its interactions with human primary immune cells through in vitro and in vivo experiments.

For energy applications, Bin Xu et al. (smtd.202201525) investigate the use of MXene-based composites to enhance antimony-based anodes in potassium batteries, where the presence of MXene in the composite significantly improves cycling stability by reducing anode expansion and degradation issues. Yury Gogotsi et al. (smtd.202201551) explore the application of vanadium and niobium-based MXenes in composites with vanadium oxide for asymmetric supercapacitors. Zifeng Lin et al. (smtd.202201526) employ MXenes in supercapacitors coupled with an aqueous $AlCl_3$ electrolyte, achieving a large potential window and excellent stability. Zhi Wei Seh et al. (smtd.202201598) report the use of MXenes, specifically $Mo_2Ti_2C_3$, as a free-standing foil for deeply rechargeable magnesium metal batteries. Qing Huang et al. (smtd.202300054) demonstrate the synthesis of a high entropy M_2GaC MAX phase, followed by its exfoliation with Lewis acid molten salt to produce the corresponding MXene. The exfoliated MXene is utilized as an electrode in lithium batteries, exhibiting long-term stability. Michael Naguib et al. (smtd.202300193) investigate the use of MBene, a boron-based 2D MXene, for energy storage. Lithium-ion batteries are fabricated using exfoliated MAB phases, MoAlB and

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Mo_2AlB_2, as the electrodes. Surface chemistry control for energy applications is demonstrated in the research article by Zdenek Sofer et al. (smtd.202201329), presenting a functionalization method based on triethoxysilyl to introduce zwitterionic functionalities. The method significantly enhances the capacitance of electrodes for supercapacitor applications. Chong Min Koo et al. (smtd.202201715) present a novel synthesis method for the Ti_3AlC_2 MAX phase and the corresponding $Ti_3C_2T_x$ MXene using recycled TiO_2 as a titanium source. The MXene prepared from recycled titanium oxide exhibits excellent conductivity and shielding properties. Additionally, Babak Anasori et al. (smtd.202300030) provide detailed experimental methods for synthesizing high-quality Ti_3C_2 MXene using various etchant and delamination procedures.

The contributions in this special issue show the broad application potential of MXenes not only for electrochemical energy storage, but also for catalysis, electronics, biomedical applications, sensing, and many others, demonstrating the bright future of MXenes. We thank all the invited contributors listed above that made this special issue possible. We thank Dr. Maria Ronda-Lloret, editor of *Small Methods*, and all the editorial staff for the invitation to be guest editors and for processing this special issue.

Conflict of Interest

The authors declare no conflict of interest.