MXene surface chemistry and topochemical conversions

Zdenek Sofer[1]

[1] *Dept. of Inorganic Chemistry, University of Chemistry and Technology Prague, Technicka 5, 166 28 Prague 6*

zdenek.sofer@vscht.cz

MXene materials have gained significant attention in recent years for their extensive studies in energy storage and conversion, as well as catalysis. Their remarkable properties, including high electrical conductivity, versatile surface chemistry, and excellent chemical stability, provide substantial advantages for these applications. This talk aims to explore the vast potential of MXene and its surface chemistry in unlocking enhanced performance across various fields.The surface chemistry of MXene can be precisely tailored using alternative chemical methods such as MAX phase exfoliation or chemical treatment of exfoliated MXene. Exfoliation of MXene through hydrogen fluoride methods (e.g., HF or LiF systems) results in a mixed surface termination comprising fluorine and oxygen functionalities. The oxygen functionalities, such as hydroxyl groups, can be further functionalized using triethoxysilane derivatives, creating Ti-O-Si bonds and facilitating effective surface modifications [1]. Covalent bonding of zwitterionic compounds onto the MXene surface presents a promising strategy for significantly improving MXene's performance in supercapacitor applications. Another approach involves topochemical conversion through the reaction of MXene with chalcogen and other elements, such as phosphorus or nitrogen, leading to chalcogen termination or the formation of composites consisting of MXene composites with unusual new properties. These hybrid materials hold potential for applications in supercapacitors, photodetectors, as well as catalysts for electrochemical nitrogen reduction and water splitting. The rich surface chemistry of MXene offers numerous possibilities for controlled functionalization, catering to various applications not only in energy storage but also in optoelectronic and sensing applications. This plenary talk will delve into the advancements in MXene research, highlighting the importance of surface chemistry and its profound impact on performance. Through a comprehensive examination of functionalization strategies and their applications, we aim to demonstrate the vast potential of MXene in driving innovation across multiple disciplines.

This work was supported by ERC-CZ program (project LL2101) from Ministry of Education Youth and Sports (MEYS).