Functionalization of MXene for energy storage and catalysis

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MXene are currently broadly studied for application in energy storage and conversion as well as in catalysis. Huge advantage for these applications originate from its high electrical conductivity, variability in surface chemistry and good chemical stability. The surface chemistry can be tuned by various methods using alternative chemical methods of MAX phase exfoliation or by chemical treatment of exfoliated MXene. The MXene exfoliated by hydrogen fluoride methods (like based on HF or LiF systems) led to mixed surface termination consisting from fluorine and oxygen functionalites. The oxygen functionalites like hydroxyl groups can be functionalized using triethoxysilane derivatives giving Ti-O-Si bond and can be effectively used for effective modifications of surface[1]. Schematic drawing of functionalization process is on Figure 1. Covalent bonding of Zwitterionic compounds on MXene surface can significantly improve performance of MXene in supercapacitor applications. Other strategy based on topochemical conversion by reaction of MXene with chalcogen and other elements like phosphorus or nitrogen can convert surface to chalcogen termination or even formation of composite consisting from dichalcogenide and modified MXene. These hybrid materials can be applied in supercapacitors, photodetectors as well as catalysts for electrochemical nitrogen reduction or water splitting. MXene surface chemistry offer a lot of variabilities for controlled functionalization for various applications not only for energy storage but also for optoelectronic and sensing applications.

References

[1] Lukáš Děkanovský, Jalal Azadmanjiri, Martin Havlík, Pal Bhupender, Jiří Šturala, Vlastimil Mazánek, Alena Michalcová, Lunjie Zeng, Eva Olsson, Bahareh Khezri, Zdeněk Sofer, Small Methods, (2023) 2201329 (https://doi.org/10.1002/smtd.202201329}.

Figures

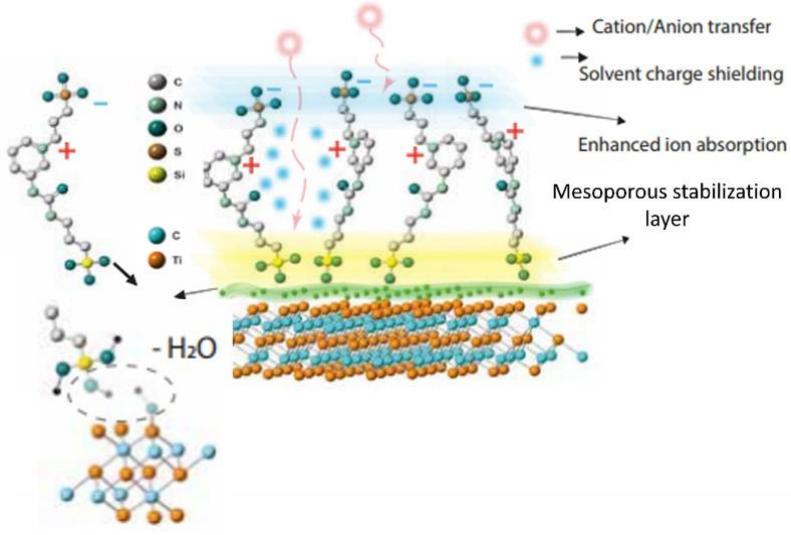

Figure 1: Schematic functionalization of MXene with Zwitterionic molecules.