

MXenes in separation science

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One of the factors that classify supramolecules is based on dimension, which is specifically the effect on the physicochemical properties of compositions. Two-dimensional compounds are the most well-known materials in this category. Graphene, Boron Nitride, and Transition Metal Dichalcogenides are examples of bi-dimensional materials. Metal carbides and nitrides which are called MXenes are the new members of this big family. These solid layered crystals with particular characteristics are widely applied in various fields such as biotechnology, medicine, and engineering. MXenes are lamellar crystals that are taken frequently by selective extraction of the A-portion sheets from the corresponding parent MAX phase bulk ceramics, with the general stoichiometric formula of $M_{n+1}AX_n$ where M stands for early transition metal (Ti, Mo, V, etc.), A mainly refers to a group IIIA or IVA element, X is Carbon and/or Nitrogen, and $n = 1, 2$, or 3 . The MAX phase structure can be explained via strong mixed covalent/metallic/ionic M-X bond whereas the character of the M-A bond is metallic. Since for the etching process, hydrofluoric acid or solutions of fluoric salt are usually used, termination molecules (e.g., O, OH, or F) as represented ‘T’ in $M_{n+1}X_nT_x$ ($n = 1, 2, 3$) are placed on the flat sheet of MXene [1]. These different functional terminations make MXene extraordinary compared to other bi-dimensional materials. They also affect the role of MXene in adsorption applications. The porosity and high surface area are other important reasons which lead MXene to be applicable for the removal of specific kinds of pollutants and used as a kind of membrane to adsorb heavy metals, organics, and pigments from various media [2]. The large interlayer spaces in the stacked networks of MXenes, these porous materials exhibit high suitability for gas adsorption [3]. Also, the reusability of porous MXene leads this bi-dimensional material to be an environmental-friendly and economical sorbent among wide ranges of other sorbents [4]. Finally, it can be concluded that MXenes are interested significantly in the analytical chemistry field as sorbents because of their unique features.

Keywords: Bi-dimensional, MXene, Sorbent.

References

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