Colloidal Properties and Stability of 2D Ti₃C₂ and Ti₂C MXenes in Water

A. Rozmysłowska^{1,*}, T. Wojciechowski¹, W. Ziemkowska¹, L. Chlubny², A. Olszyna¹, S. Poźniak¹, K. Tomkiewicz¹, A. M. Jastrzębska¹

¹ Warsaw University of Technology, Faculty of Materials Science and Engineering, 02-507 Warsaw, Woloska 141, Poland

² AGH University of Science and Technology, Faculty of Materials Science and Ceramics, 30-059 Krakow, Mickiewicza 30, Poland

*E-mail: anita.rozmyslowska@gmail.com

doi: 10.20964/2018.11.56

Received: 29 May 2018 / Accepted: 27 July 2018 / Published: 1 October 2018

While MXenes have been utilized in many applications, their surface properties in water systems are still unexplored, especially in the aspect of colloidal properties, which highly limits their practical use. In this study, the colloidal properties and stabilities of 2D Ti₃C₂ and Ti₂C MXenes were investigated using time-resolved dynamic light scattering and zeta potential over a wide range of waters (deionized water, tap water and physiological NaCl solution of 0.9%) relevant to natural and engineered systems. Our results indicate that pH has a significant influence on Ti₃C₂ and Ti₂C stabilities from pH 4 to 10. The type of water environment also affects the stability of Ti₃C₂ and Ti₂C due to electrical double layer compression. The aggregation and stabilities of Ti₃C₂ and Ti₂C in the aquatic systems followed colloidal theories, even though Ti₃C₂ and Ti₂C flakes shape is not spherical. The presence of NaCl stabilized more the 2D Ti₃C₂ than the 2D Ti₂C. Dispersions prepared when using tap water were more stable in the case of Ti₂C compared to the NaCl solution. The opposite effect was found for Ti₃C₂. This may be due to the binding capacity of Ca²⁺ ions with hydroxyl and carbonyl functional groups whose amounts vary on the surface of Ti₃C₂ and Ti₂C. In general, our study demonstrates that the 2D flakes of Ti₃C₂ MXenes are highly stable in NaCl, although they settle more quickly in tap water. The 2D flakes of Ti₂C MXenes are more stable in distilled water and less stable in the physiological NaCl solution.

Keywords: 2D Ti₃C₂, 2D Ti₂C, MXenes, dynamic light scattering, zeta potential, stability, safety

[FULL TEXT](#)

© 2018 The Authors. Published by ESG (www.electrochemsci.org). This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).