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WEBINAR SERIES

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Tuesday, May 17
15:00 (Israel time)

Prof. Yury Gogotsi

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MXenes as Ion Hosts for Energy Storage

Abstract

Discovery of new materials provides moments of inspiration and shifts in understanding, shaping the dynamic field of materials science. Following the graphene breakthrough, many other 2D materials emerged. Although many of them remain subjects of purely academic interest, others have jumped into the limelight due to their attractive properties, which have led to practical applications. Among the latter are 2D carbides and nitrides of early transition metals known as MXenes [1]. The family of MXenes has been expanding rapidly since the discovery of Ti3C2 in 2011. More than 30 different stoichiometric MXenes have been reported, and the structure and properties of numerous other MXenes have been predicted. Moreover, the availability of solid solutions on M and X sites, multi-element high-entropy MXenes, control of surface terminations, and the discovery of out-of-plane ordered double-M o-MXenes (e.g., Mo2TiC2), as well as in-plane i-MXenes, offer a potential for producing up to a thousand of new distinct structures and an infinite number of solid solutions. This presentation will describe the state of the art in the synthesis of MXenes, their delamination into single-layer 2D flakes and assembly into films, fibers and 3D structures. The versatile chemistry of the MXene family renders their properties tunable for a large variety of applications. In particular, MXenes can act as host structures for cations and molecules. Chemical and electrochemical insertion of ions and molecules between the MXene layers allows modification of their properties, as well as electrochemical charge storage and harvesting, which use both, double-layer and redox mechanisms. We have developed an optical technique for monitoring the charge transfer during charge/discharge in-situ, which allows identification and quantitative analysis of changes in the oxidation state of transition metals without using expensive in-situ techniques, such as XAS or TEM/EELS.

1. A. Vahid Mohammadi, J. Rosen, Y. Gogotsi, The World of Two-Dimensional Carbides and Nitrides (MXenes), Science, 372, eabf1581 (2021)

Yury Gogotsi is Distinguished University Professor and Charles T. and Ruth M. Bach Professor of Materials Science and Engineering at Drexel University. He also serves as Director of the A.J. Drexel Nanomaterials Institute. His research group works on 2D carbides, nanostructured carbons, and other nanomaterials for energy, water and biomedical applications. He is recognized as Highly Cited Researcher in Materials Science and Chemistry, and Citations Laureate by Thomson-Reuters/Clarivate Analytics. He has received numerous awards for his research including the MRS Medal, ACS Award in the Chemistry of Materials, Gamow Prize, European Carbon Association Award, and S. Somiya Award from IUMRS. He has been elected a Fellow of the World Academy of Ceramics, the European Academy of Sciences, American Association for Advancement of Science, Materials Research Society, American Ceramic Society, the Electrochemical Society, Royal Society of Chemistry, and the International Society of Electrochemistry. He holds honorary doctorates from several European Universities.