IAP Seminar

Yury Gogotsi

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Friday, 15th September 2023, 11:00 a.m.
TU Wien, Institut für Angewandte Physik, E134
1040 Wien, Wiedner Hauptstraße 8-10,
Yellow Tower „B“, 2nd floor, FH Hörsaal 7 - GEO

The seminar will be also held as a zoom Meeting
https://tuwien.zoom.us/j/61835319839?pwd=cFBXYm8rRitIbjR1U1l1UjMrdlZxdz09
Password: 2GQhwRXG

MXenes: 2D Building Blocks for the Real-World Sustainable Technology

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 transition metals known as MXenes [1]. The family of MXenes has been expanding rapidly since the discovery of Ti_3C_2 in 2011. More than 50 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., Mo_2TiC_2), as well as in-plane ordered *i*-MAX phases and their *i*-MXenes offer a potential for producing dozens of new distinct structures [2]. This presentation will describe the state of the art in the manufacturing of MXenes with a focus on emerging methods, beyond aqueous etching in fluoride-containing acidic solutions; their delamination into single-layer 2D flakes and assembly into films, fibers and 3D structures. Synthesis-structure-properties relations of MXenes will be addressed on the example of Ti_3C_2. The versatile chemistry of the MXene family renders their properties tunable for a large variety of applications. In particular, the properties of MXenes can be controlled via their surface chemistry, composition and structure, as well as electrochemically modulated. For example, Mo-terminated MXenes offer a high electrocatalytic activity for hydrogen evolution reaction (HER), while Ti-terminated MXenes are good for aqueous electrochemical energy storage. MXenes can also be used in tribology, mechanical reinforcement of metal, ceramic and polymer matrix composites, telecommunication, energy harvesting and storage, healthcare, and electronic device applications.

1. Vahid Mohammadi, J. Rosen, Y. Gogotsi, The World of Two-Dimensional Carbides and Nitrides (MXenes), ***Science***, **372**, eabf1581 (2021)
2. Anasori, Y. Gogotsi, MXenes –Trends, Growth, and Future Directions, ***Graphene and 2D Materials***, **7**, 75-79 (2022)

Yury Gogotsi is a distinguisged professor and director of the A.J. Drexel Nanomaterials Institute, with research interests on synthesis and surface modification of inorganic nanomaterials and two-dimensional carbides and nitrides (MXenes). Prof. Gogotsi obtained his PhD in Physical Chemistry at Kiev Polytechnic in 1986. His intrest in ceramic materials led to the discovery of MXenes in 2011. Currently he is a leader scientist in the U.S. (ranked #53 in the 2019 Stanford's list of top 2% living and deceased researches in the world across all scientific disciplines), with key pubblication in the field of 2D materials and numerous academic distinctions.

All interested colleagues are welcome to this seminar lecture (45 min. presentation followed by discussion).

Friedrich Aumayr
(LVA-Leiter)

Markus Valtiner
(Seminar Chair)