Facile micropatterning of salt-residue free MXene thin-films

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Abstract

Advanced 2D materials, like MXenes, exhibit remarkable electrical, mechanical, and thermal attributes, making them favorable substitutes in integrated circuit architectures where traditional metal elements are challenged by continuous miniaturization and power limitations. In this work, we introduce a scalable method for crafting sub-10 nm MXene thin-film patterns by combining lithography and spin-coating techniques. This approach ensures the formation of uniform micropatterns, while an innovative, uncomplicated HCl treatment step effectively purges salt residues, a recurrent issue in MXene synthesis. The resultant MXene films are about 6-7.5 nm thick, optically transparent, and capable of being precisely micropatterned with lateral resolutions down to 2 μm. Rigorous analysis indicates these films exhibit exceptional conductivity with high photosensitivity of the MXene–Si junction. The proposed method seamlessly integrates with prevailing microelectronics manufacturing setups, marking a substantial advancement towards the utilization of MXenes in flexible, transparent, and wearable electronics, from interconnects and electrodes to highly sensitive photodetectors.

Short Biography

Maxim Sokol earned a B.Sc. in Physics and degrees in Materials Engineering (B.Sc., M.Sc., Ph.D.) from Ben-Gurion University of the Negev, Beer-Sheva, Israel. After his Ph.D., he joined Drexel University in Philadelphia, PA, USA, as a Stein fellow in the Layered Solids Group.

Currently, Maxim Sokol serves as a faculty member at the Department of Materials Science and Engineering at Tel-Aviv University, Israel. His research is deeply focused on the processing of advanced ceramics and ceramic composites, including but not limited to nanostructured transparent oxides and layered ceramics (e.g., MAX and MAB phases). Furthermore, Sokol is actively involved in exploring the exfoliation of these materials into 2D forms, known as MXenes, and delves into the characterization and modeling of the physical and mechanical properties of ceramics and ceramic-based nanocomposites.