

Title: Research on Multimodal Sensors Based on Two-Dimensional MXene Materials

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Abstract:

The rapid advancement of flexible electronics has created an urgent demand for high-performance, low-cost, and scalable sensors. Two-dimensional transition metal carbides and nitrides (MXenes) have emerged as a star material for constructing next-generation flexible sensors, owing to their exceptional metal-like electrical conductivity, hydrophilicity, tunable surface functional groups, and outstanding mechanical flexibility.

My research focuses on systematically investigating the application of MXene materials in temperature, pressure, and strain sensing. High-quality few-layer MXene nanosheets will be synthesized from MAX phases such as $\text{Ti}_3\text{C}_2\text{T}_x$, Nb_2CT_x , and $\text{Mo}_2\text{TiC}_2\text{T}_x$ through etching and exfoliation processes. The MXene will be formulated into a stable material with suitable viscosity and deposited onto various flexible substrates using advanced patterning techniques to achieve efficient, controllable, and scalable sensor fabrication.

The expected outcomes of this study will provide important experimental and theoretical foundations for developing multifunctional integrated sensing platforms based on a single active material, MXene. The proposed strategies are anticipated to promote the practical application of flexible sensors in artificial intelligence, health monitoring, human-machine interfaces, and beyond.