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Optimization of Photodetection Analysis for MXene Thin Films

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Abstract

MXenes, a novel class of 2D materials, have garnered increasing attention for various photovoltaic and optoelectronic applications due to their tunable properties. The response of MXenes to various stimuli such as light, humidity, and storage condition is under investigation, even for the canonical material $Ti_3C_2T_x$. The aim of this work is to develop and optimize the analysis procedure for probing the effects of light, electrical contact, and environment on optoelectronic properties of $Ti_3C_2T_x$ and $Mo_2TiC_2T_x$ MXenes for photodetection applications. The best configuration for optoelectronic characterization involves placing a mask over the inactive area on the substrate, using a transparent conducting oxide with an etched channel as an electrical contact method, and maintaining an inert environment throughout the characterization. Allowing illumination on the inactive area as well as the electrodes suppresses the photoresponse of MXene. Using silver paste as an electrical contact influenced the photoresponse of the material, as it suppressed, heightened, or even changed the sign of the photoresponse. Both materials are also sensitive to ambient environment; they destabilize in room air, and conductance sharply decreases. Disentangling the effects of contact method, substrate, and temperature on photoresponse will further our fundamental understanding of the optoelectronic behavior of MXenes and will open a multitude of opportunities for this rising class of 2D materials.