$Ti_3C_2T_x$ MXene-Based Flexible Wearable Sensors for VOCs

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$Ti_3C_2T_x$ MXenes are emerging as a highly promising active material for flexible and room-temperature chemiresistive sensing devices. They exhibit high electrical conductivity, large surface area, and surface-termination tunability, making them ideal for fabricating versatile gas-sensing devices. Despite extensive studies on MXene-based sensors, the influence of flakes assembly, spatial distribution, substrate interaction and sensing mechanism remains largely elusive. In this work, $Ti_3C_2T_x$ MXene flakes synthesized via Minimally Intensive Layer Delamination (MILD) route were deposited on alumina, glass and flexible PET substrates to elucidate substrate dependant sensing characteristics and establish active material-substrate correlation. Structural and morphological characterization using X-Ray Diffraction, Raman Spectroscopy, AFM, SEM and TEM revealed formation of single- and multi-layer flakes with variation in flake morphology and distribution in different substrates. These structural and interfacial differences directly affect the sensing response towards our target Volatile Organic Compounds (VOCs), including toluene, isoprene, acetone, and ethanol. Films deposited on PET exhibited a significant response to these VOCs at room temperature, highlighting suitability for wearable sensors. Additionally, preliminary studies of isolated MXene flakes on PET suggested the potential to probe the vapour adsorption behaviour at the single-flake level. Collectively, these findings provide insight into the behaviour of the $Ti_3C_2T_x$ MXene films and show significant potential for next-generation wearable sensing platforms under ambient conditions.

References

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