

Room-temperature NO₂ sensing with engineered MoSe₂ via tailored exfoliation and self-Assembly

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Abstract

Atmospheric nitrogen dioxide (NO₂) is a harmful air pollutant, and its reliable detection at room temperature (RT) under ambient conditions remains a significant major challenge for gas-sensing technologies [1]. Two-dimensional transition metal dichalcogenides (TMDs), such as MoSe₂, have attracted considerable interest for gas-sensing applications due to their high surface area, unique electronic properties and narrow bandgap. However, the lack of scalable, cost-effective, and reproducible synthesis and film fabrication methods for TMDs significantly limits their practical deployment as gas sensors. In this work, we report a tailored liquid-phase shear (LPSE) exfoliation method combined with an interfacial self-assembly approach to produce MoSe₂ nanosheets (2-5 layers) with high crystalline quality and narrow later size distribution (70-110 nm). Highly stacked, interconnected and continuous MoSe₂ ultrathin films (~40 nm) were successfully fabricated via controlled interfacial self-assembly approach. The resulting MoSe₂-based chemiresistive sensor exhibits high sensitivity toward NO₂ (17.5% at 100 ppb), along with good selectivity, repeatability and stable performance under ambient conditions. This work demonstrates an effective, low-cost structural engineering strategy to overcome the limitations of TMD-based gas sensors and highlights the potential of MoSe₂ for RT NO₂ sensing applications.

References

- [1] P. Saxena, "Identifying the Sources of Primary Air Pollutants and Environmental Health: A Review," 2016. [Online]. Available: www.erpublication.org