The origin and mitigation of defects induced by metal evaporation in 2D materials

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Evaporating metals on 2D materials is crucial for building electronic devices but often damages the material by breaking bonds and causing metal penetration, which degrades device performance. While ultra-high vacuum (10^{-9} Torr) evaporation reduces such damage, it is costly and inefficient. This study explores a simpler alternative by evaporating Au in moderate vacuum (5×10^{-6} Torr) on defect-free, mechanically exfoliated 2D materials. Cross-sectional TEM analysis reveals that this approach preserves the van der Waals interface with minimal defects. Density functional theory simulations suggest that surface water molecules slightly distort the crystal lattice, lowering the energy required for defect formation. Devices fabricated with Au/h-BN/Au structures at 5×10^{-6} Torr show reduced leakage current compared to those made at 3×10^{-5} Torr, offering a practical solution to integrate 2D materials into electronics.

References

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Figures

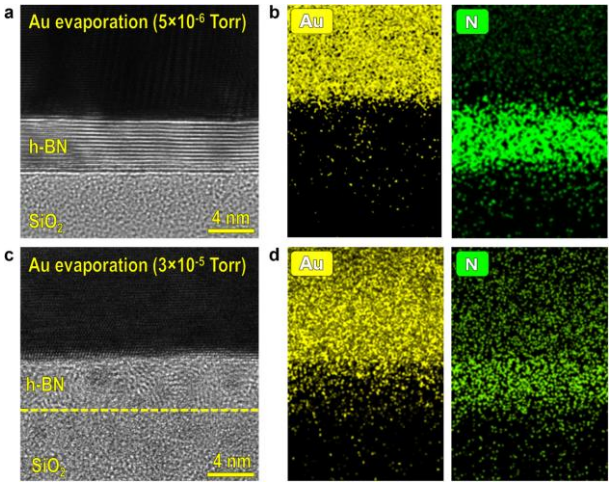

Figure 1: Morphological and chemical analysis of mechanically exfoliated h-BN flakes.

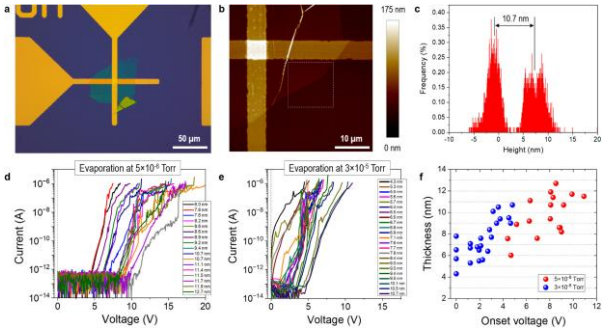

Figure 2: Leakage current across h-BN with Au electrodes evaporated at 3×10^{-5} and 5×10^{-6} Torr.

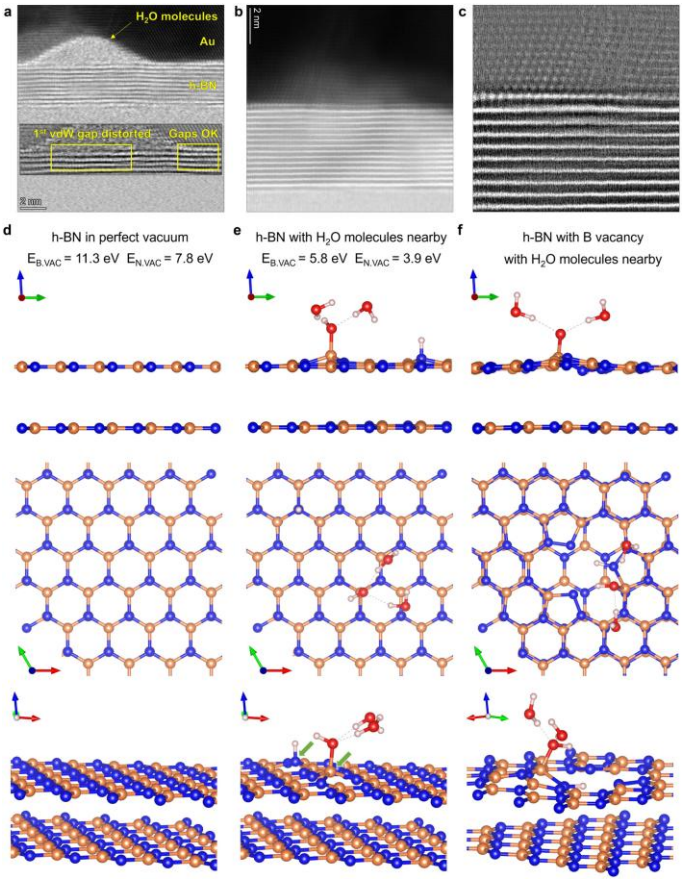

Figure 3: Origin of the evaporation-induced effects.