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SYNTHESIS OF 2D FLATLANDS

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I will present our investigation of chemical vapor deposition (CVD)-growth, achieving localized, patterned, single crystalline or polycrystalline monolayers of TMDs, including MoS_2, WS_2, WSe_2 and $MoSe_2$, as well as their heterostructures. We study CVD-growth and perform extensive material characterization to illuminate the role of dissimilar 2D substrates in the prevention of interior defects in transition metal dichalcogenides (TMDs), thus uncovering the conditions for anti-oxidation. We further demonstrate the epitaxial growth of TMDs on hBN and graphene, as well as vertical/lateral heterostructures of TMDs, uniquely forming in-phase 2D heterostructures. This research provides a detailed observation of the oxidation and anti-oxidation behaviours of TMDs, which corroborate the role of underlying 2D layers in the prevention of interior defects in TMDs. If the technique could be developed to be highly reliable and high fidelity, it could have a large impact on the future research and commercialization of TMD-based devices. Furthermore, we develop flexible electrodes and energy storage toward wearable and multifunctional electronics. Here, we develop a facile fabrication technique utilizing vertically aligned carbon nanotubes (VACNTs), which enables high-throughput fabrication of flexible supercapacitors. We develop an innovative technique, which facilitates a stable charge/discharge under varied strains. Our structure shows a high flexibility and stability during stretching up to 20% and bending up to 180 degrees. These flexible supercapacitors are promising for various flexible electronics applications. Building on these previous results from 2D material growth and flexible electrodes, our next step is to combine 2D materials with flexible substrates toward next generation wearable detectors.

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