Tungsten disulfide on graphene: structural, electronic, nanotribological properties and optoelectronic applications

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In this talk recent advances on the synthesis, properties and applications of the van der Waals (vdW) heterostack tungsten disulfide (WS_2) on graphene will be presented. It will be shown that large-area highly-crystalline monolayer WS_2 can be synthesized with a vapor phase approach both on graphene arrays obtained via chemical vapor deposition (CVD) on copper (Cu) foil [1] and on epitaxial graphene on silicon carbide (SiC) [2]. It will be shown via microstructural and electronic characterization that WS_2 aligns on top of graphene with a 0° orientation, the interface is atomically sharp and the spin-orbit splitting of monolayer WS_2 on epitaxial graphene is the largest reported to date [3]. Also, experimental data and molecular dynamics simulations showing superlubric sliding of monolayer WS_2 nanoflakes over epitaxial graphene triggered by a scanning tunneling microscopy (STM) tip will be presented. Finally, the fabrication of a scalable hybrid WS_2/graphene photodetector with a maximum responsivity $R \sim 220\ A \cdot W^{-1}$ and a −3 dB bandwidth of 250 Hz will be demonstrated [4]. In virtue of its band alignment, remarkable spin-orbit splitting, atomically sharp interface and noanotribological properties this vdW heterostack holds exciting prospects for the implementation of advanced optoelectronic multifunctional devices.

References:
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