Unlocking the Potential of Atomically-Thin Semiconductors

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This work reports on recent advances in precise engineering of two-dimensional semiconductors (2dSEM) based on van der Waals metal chalcogenide layers, such as indium selenide and gallium selenide, and their heterostructures.

These 2DSEM feature high electron mobilities and an electronic band structure tunable by composition and layer thickness [1]. The interest in their unique "Mexican hat" valence band is motivated by the possibility to create and manipulate new forms of charge, magnetic, and superconducting order [2]. Also, they provide an ideal platform to investigate the physics of electron spins in semiconductor spintronic devices due to the weak van der Waals forces between the layers, their atomically sharp interfaces and versatile eletronic properties. 2DSEM-based magnetic tunnel junctions can be realized by combining magnetic and non-magnetic layers. These junctions reveal new tunneling magnetoresistance phenomena [3-4] and giant anomalous zero-bias spin voltage [5]. Just as the nonlinear response of traditional semiconductor junctions was pivotal for the development of early transistors, the magnetic phenomena demonstrated here have the potential to inspire new concepts for spin-based logic and amplification in modern electronics.

References:

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