

Scientific recognition for Dr. Fazel Shojaie

A paper by Dr. Fazel Shajaie with his collaborations entitled “Thickness-dependent bandgap and electrical properties of GeP nanosheets” has been accepted for publication in the Journal of Materials Chemistry A (IF=10.733). The School of Nano Science congratulates this achievement to Dr. Shojaie, our part-time researcher, and his colleagues.

Description:

Recently there have been extensive efforts to develop novel two-dimensional (2D) layered structures, owing to their fascinating thickness-dependent optical/electrical properties. Herein, we synthesized thin GeP nanosheets that had a band gap (E_g) of 2.3 eV, which is a dramatic increase from the value in the bulk (0.9 eV) upon exfoliation. This E_g value is close to that of the GeP monolayer predicted by first-principles calculations (HSE06 functional). The calculations also indicate a strong dependence of E_g on the number of layers (2.306, 1.660, 1.470, and 1.397 eV for mono-, bi-, tri-, and tetralayers, respectively), and that the band edge positions are suitable for water splitting reactions. Field-effect transistor devices were fabricated using the p-type GeP nanosheets of various thicknesses, and the devices demonstrated a significant decrease in the hole mobility but an increased on–off ratio as the layer number decreased. The larger on–off ratio (10^4) for the thinner ones is promising for use in novel 2D (photo)electronic nanodevices. Further, liquid-exfoliated GeP nanosheets (thickness = 1–2 nm) deposited on Si nanowire arrays can function as a promising photoanode for solar-driven water-splitting photoelectrochemical (PEC) cells. Based on the calculated band offset with respect to the Fermi levels for the two half-reactions in the water splitting reaction, the performance of the PEC cell can be explained by the formation of an effective p-GeP/n-Si heterojunction.

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