EuroSciCon

Euroscicon Conference on
Physical Chemistry and
Analytical Separation Techniques

October 08-09, 2018
Amsterdam, Netherlands

J Org Inorg Chem 2018 Volume: 4
DOI: 10.21767/2472-1123-C6-018

INTERFACE ENGINEERING AND FORCE TUNING ELECTRICAL TRANSPORT BEHAVIOUR OF NANO-DEVICES BASED ON ATOMIC LAYERED MOS_2

Junjie Qi and Feng Li
University of Science and Technology Beijing, People's Republic of China

High-performance piezoelectricity in monolayer semiconducting transition metal dichalcogenides is highly desirable for the development of nanosensors, piezotronics and photopiezotransistors. Here, we report the experimental study of the theoretically predicted piezoelectric effect in triangle monolayer MoS_2 devices under isotropic mechanical deformation. The experimental observation indicates that the conductivity of MoS_2 devices can be actively modulated by the piezoelectric charge polarization-induced built-in electric field under strain variation. These polarization charges alter the Schottky barrier height on both contacts resulting in a barrier height increase with increasing compressive strain and decrease with increasing tensile strain. The underlying mechanism of strain-induced in-plane charge polarization is proposed and discussed using energy band diagrams. In addition, a new type of MoS_2 strain/force sensor built using a monolayer MoS_2 triangle is also demonstrated. Our results provide evidence for strain-gating monolayer MoS_2 piezotronics, a promising avenue for achieving augmented functionalities in next-generation electronic and mechanical-electronic nanodevices. Developing nanoelectronics that utilize the vertical sub-nanometer thickness of two-dimensional materials is desirable for achieving miniaturization of circuit elements. However, only a few researches have been studied in the vertical transport of atomic layered materials so far. Here, the vertical electrical transport behaviour of bilayer MoS_2 under coupling of photons and force is explored by the use of conductive atomic force microscopy. We found that the current-voltage behaviour across the tip-MoS_2-Pt junction is a tunnelling current which can be well fitted by a Simmons approximation. Among which, direct tunneling is dominated at low bias voltages whereas Fowler-Nordheim tunneling is happened at high bias voltages. The bias voltages in transition point between direct and Fowler-Nordheim tunneling are matched with the tunnelling barrier height of energy band shape difference. Furthermore, the source-drain current dropping surprisingly appears when we continually increase force in which the dropping point is altered by light provided. The potential mechanism is responsible for the tuning in tunnelling barrier height and width by force and photons. These results provide a new way to design devices that takes advantage of ultrathin two-dimensional materials. Such ultra-short channel length electronic components that possess tunnelling current are important for establishing high-efficiency electronic and optoelectronic systems.

junjieqi@ustb.edu.cn