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Explore intrinsically electrical characteristics of atomically thin SnS_2 flake

Abstract
The interface problems in nanowire-based electronics play important roles in nanoelectronics multiply enormously the contribution of electrical contact properties. Here, the intrinsically electrical characteristics of atomically thin SnS_2 field effect transistor (FET) device were explored in detail. Four layers (c.a. 2.3 nm) of SnS_2 flakes were obtained via mechanical exfoliation from a semiconducting SnS_2 bulk crystal grown by chemical vapor transport and then deposited on a heavily doped Si substrate covered with a 285-nm-thick SiO_2 layer. The number of layers for SnS_2 flakes was quickly determined by images existing difference in the contrast of the color of optical microscope and atomic force microscope. To investigate the electrical properties of atomically thin SnS_2 flakes, SnS_2 FETs were fabricated using standard e-beam lithography and thermal evaporation. As the experimental results, the good performance, including a high on/off ratio up to 10^5 and a mobility ~3.2 $cm^2V^{-1}s^{-1}$, of SnS_2 FET applied in this study can be achieved. Moreover, on the basis of analysis of temperature dependent resistance between two- and four-terminal FETs, we found that the resistance increases with temperature decreasing. The contact resistance can be extracted to c. 5 % of total resistance, implying the contact resistance can be eliminated without additional treatment during fabrication processes of SnS_2 FETs. Besides, we report the unprecedented measurements, low frequency noise, of SnS_2-based FETs. The measured results provide detailed insights of the electrical properties of SnS_2 FETs for the first time, might be useful for optoelectronic nanodevice applications in industrial.