Investigation of the factors limiting the contact resistance between metal and 2D semiconductor

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Abstract

The performance of electronic and optoelectronic devices based on two-dimensional layered semiconductors (2D SC) of the transition metal dichalcogenide family such as molybdenum disulphide (MoS2) is significantly affected by electrical contacts that connect these material with external circuitry. Low contact resistance in 2D SC based devices is critical for achieving high on current, large photoresponse and high-frequency operation [1]. For 2D SC based FET devices a major issue is the existence of a large contact resistance R_c at the interface between the 2D SC and any bulk (or 3D) metal, which drastically restrains the drain current [2-4].
Therefore it is necessary to understand the intrinsic and extrinsic factors determining R_c, which displays a strong variation depending on the metal [5]. To gain understanding of these factors to render a better control of the contact□s technology feasible, a comprehensive physics-based model of R_c is an absolute requirement. So we propose in this work a model for describing the Rc in a metal-2D SC junction, which can be conveniently treated as a Schottky barrier (SB). The Schottky barrier height (SBH) can be tuned by a gate voltage and depends on the potential step across the junction formed between 2D SC under the metal and 2D SC in the channel, which could be pp, nn, pn or np type. To get the final goal we have developed a numerical model of electrostatics in both 2D SC under metal and 2D SC in the channel, even considering possible effects of Fermi Level Pinning.

References

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Figures

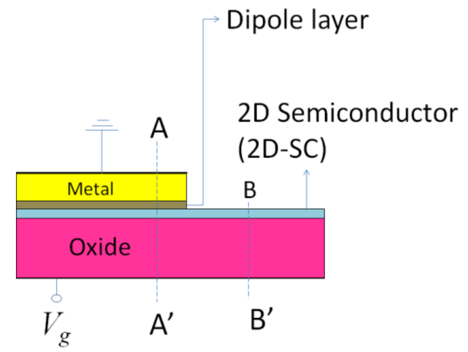

Figure 1: Sketch of the structure

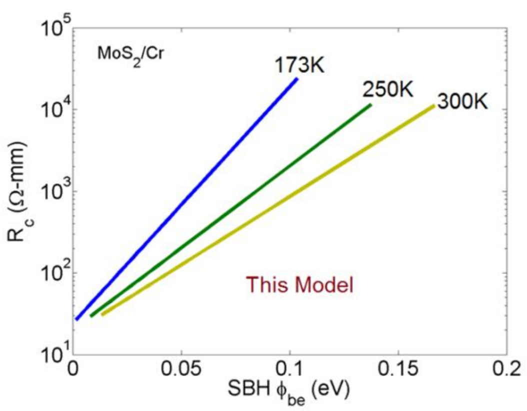

Figure 2: Contact Resistances vs Schottky barrier