Characterization of Graphene/ZnO Schottky Barriers Formed on Polar and Nonpolar ZnO Surfaces

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Unique properties of graphene-semiconductor junctions offer a great opportunity to investigate new fundamental phenomena taking place at the interface between a two-dimensional (2D) semimetal and a three-dimensional (3D) bulk semiconductor, and make this junction extremely attractive for a new generation of graphene-based devices. One of the key issues in these junctions is to understand the charge transport mechanisms. In the last few years we focused on the preparation of graphite/semiconductor junctions by simple drop casting of graphite colloidal solution with the aim to describe charge transport mechanism in such junctions [1-4]. We showed that the interaction between graphite and polar surfaces of ZnO affects electrical properties of graphite/ZnO Schottky junctions. A strong interaction of the Zn-face with the graphite contact causes interface imperfections and results in the formation of laterally inhomogeneous Schottky contacts. On the contrary, high quality Schottky junctions form on the O-face, where the interaction is significantly weaker. Moreover, we observed that the electrical properties of graphite/ZnO Schottky junctions strongly depend on the crystallographic orientation of the ZnO substrate. The current-voltage, capacitance-voltage, and impedance measurements indicate that near-ideal Schottky junctions form on c-plane, while on a- and m-plane the junctions are laterally inhomogeneous. Now we focus on a systematic analysis of charge transport mechanisms in the junctions formed by a 3D oxide semiconductor (ZnO) and 2D graphene [5]. We further attempt to deeply understand how the interaction between graphene and different crystallographic planes of oxide semiconductor affect the charge transport.

References

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