Schottky Barrier Inhomogeneity of Pt/4H-SiC Junction Probed by Metal-Base Transistor Ballistic Electron Emission Spectroscopy (BEES)

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The interfacial energy barrier, well-known as the Schottky barrier, is formed at a metal/semiconductor (MS) junction because the energy distribution of delocalized electronic states from the vacuum level is discontinuous in each bulk material [1]. The discontinuity of the energy distribution can be significantly affected by the interaction between the orbitals of metal and semiconductor atoms at the interface [2], not only the difference of the work function of metal and the electron affinity of semiconductor. Thus, the Schottky barrier height (SBH) is very sensitive to the crystallography at the interface and can vary from region to region of the MS junction, associated with the inhomogenous atomic structure at the interface. This complex physical and chemical aspects of the Schottky barrier formation strongly demand an experimental tool probing the inhomogeneous interface energy band profile. Here, we study the Schottky barrier inhomogeneity of Pt/4H-SiC(0001) junction using the metal-base transistor ballistic electron emission spectroscopy (BEES) [3]. The ratio of collector current to tunnel current (I_c/I_t) is fitted to the Bell-Kaiser (BK) theory [4] and we observe that the extracted SBH depends sharply on the collector bias (V_{CB}). We suggest that the sharp V_{CB} dependence of the extracted SBH originates from the barrier inhomogeneity. By assuming that the region parameter, related to the electrostatic characteristics of low SBH patch, has a Gaussian distribution [5], we can explain the sharp V_{CB} dependence of the extracted SBH and acquire the information about the barrier inhomogeneity. With our methodology, we can obtain the barrier inhomogeneity quite accurately without microscopic investigation. It is anticipated that our works can offer a general platform equiped with systematic analysis tools for probing the inhomogeneity of interface band structures.

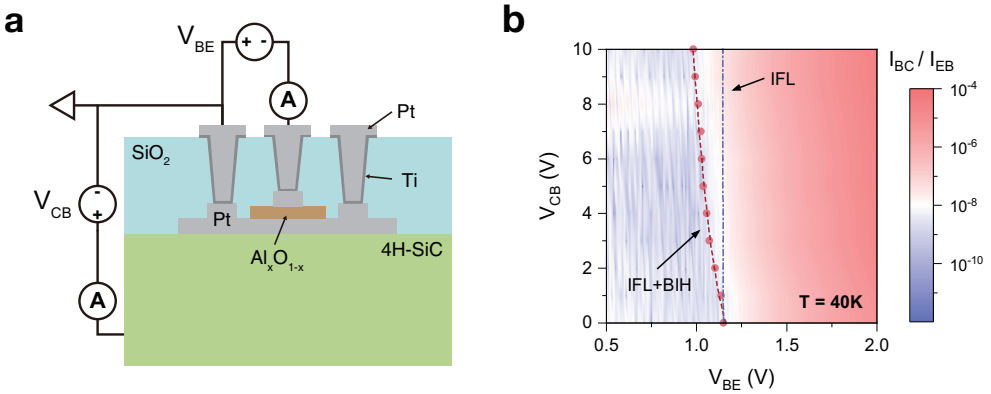

Fig. 1. **a**, The device structure and the electrical measurement configuration. **b**, BEES I_c/I_t data (color map) with the threshold voltages fitted to BK model (circles) and the estimation of their V_{CB} dependence by considering image force lowering (IFL) + barrier inhomogeneity (dashed line) or IFL only (dashed dot line) at 40 K.

References

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