Towards h-BN/GaN Schottky diodes: spectroscopic study on the electronic phenomena at the interface

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Hexagonal boron nitride together with other members of van der Waals crystals family has been studied for over a decade both in terms of fundamental and applied research. Up to now, the spectrum of h-BN-based devices has broadened significantly and systems containing the h-BN/III-V junctions have gained a substantial interest as building blocks in inter alia light emitters, photodetectors, or transistor structures. Therefore, the understanding of electronic phenomena at the h-BN/III-V interfaces becomes a question of high importance regarding device engineering. We present the investigation of electronic phenomena at h-BN/GaN interface by means of contactless electroreflectance (CER) spectroscopy. This non-destructive method enables precise determination of the Fermi level position at the h-BN/GaN interface and investigation of carrier transport across the interface. CER results showed that h-BN induces enlargement of surface barrier height at GaN surface. Such effect translates to Fermi level pinning deeper inside the GaN band gap. As an explanation we propose the mechanism based on electron transfer from GaN surface states to the native acceptor states in h-BN. We reinforced our findings by thorough structural characterization and demonstration of h-BN/GaN Schottky diode. The surface barriers obtained from CER and electrical measurements are consistent within the experimental accuracy proving that CER is an excellent tool for interfacial studies of 2D/III-V hybrids.