グラフェン・hBN・GaN ヘテロ接合によるショットキーバリアダイオードの電流輸送特性

Current transport characteristics of graphene/hBN/GaN heterojunction Schottky barrier diode

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Introduction: Recently, significant importance has been given to fabricate a graphene/GaN heterojunction considering the outstanding electronic properties of both the materials. The Schottky barrier diode (SBD) structure of graphene/GaN has great potential for ultraviolet photodiode and switching device application. The metal-insulator-semiconductor (MIS) based SBD are considered to be ideal for lowering the reverse saturation current. In this context, we studied the device properties of a graphene/hBN/GaN heterojunction SBD.

Experimental: Si-doped GaN film deposited on sapphire substrate was obtained from NGK insulators, Japan. Chemical vapor deposited graphene and hexagonal boron nitride (hBN) films were transferred on the GaN/sapphire sample for device fabrication (fig.1a). In and Al contacts were deposited by thermal evaporation technique using ULVAC VPC-260F. Current density-voltage (J-V) characteristics measurements were carried out at different temperatures using a two probe system and Keithley 2401 SourceMeter.

Results and discussion: Significant reduction of reverse saturation current was obtained with the introduction of hBN layer in graphene/n-GaN interface. Temperature dependent J-V characteristics for the graphene/hBN/n-GaN heterojunction were investigated to elucidate the current transport behavior (fig. 1b). The Schottky barrier height increased with increase in temperature from 0.77 to 0.98 eV in the temperature range of 298K to 373K, respectively. The series resistance (R_S) was also found to be temperature dependent, where R_S decreased with increase in temperature (fig.1c). The understanding of graphene/hBN/n-GaN heterojunction device characteristics can be significant for photodiode and switching device applications.

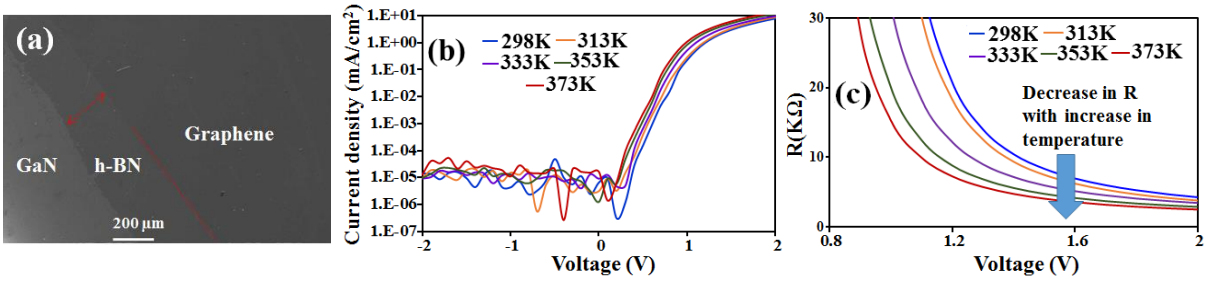

Figure 1 (a) Graphene and hBN film on GaN surface. (b) J-V characteristics and (c) resistance with respect to bias voltage in the temperature range of 298-373K for the graphene/hBN/n-GaN SBD.