Title	金属-半導体界面層あるいは絶縁体-半導体界面層を用いたAlGaN/GaNデバイスの閾値電圧制御
Author(s)	DENG, YUCHEN
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Description	Supervisor: 鈴木 寿一, 先端科学技術研究科, 博士

Abstract

We have systematically investigated effects of metal-semiconductor or insulator-semiconductor interfacial layers (ILs) in AlGaN/GaN devices, where AlO_x, TiO_x, or NiO_x is employed as an IL. From capacitance-voltage characteristics of metal/IL/AlGaN/GaN devices with a metal-semiconductor IL between the gate metal and AlGaN, it is shown that the IL modulates the threshold voltage V_{th}, attributed to the vacuum level step induced by the dipole of the IL. We find negative vacuum level steps for AlO_x and TiO_x ILs, and positive for NiO_x, from which the IL dipole density is estimated for each IL material. The two-dimensional electron gas carrier concentration in the metal/IL/AlGaN/GaN devices is also modulated by the vacuum level step. Furthermore, X-Ray photoelectron spectroscopy of the IL/AlGaN interfaces suggest a formation of NiGa in the NiO_x/AlGaN interface. On the other hand, from capacitance-voltage characteristics of metal/Al_2O_3/IL/AlGaN/GaN devices with an insulator-semiconductor IL between Al_2O_3 and AlGaN, the fixed charge density of the Al_2O_3/IL/AlGaN interface is evaluated by the Al_2O_3 thickness dependence of V_{th}. For AlO_x and TiO_x ILs, the fixed charge density is higher than that of the Al_2O_3/AlGaN interface with no IL, while lower for NiO_x. The fixed charge density for an IL shows a positive correlation with the IL dipole density, suggesting that the fixed charge is related to the unbalanced IL dipole. Furthermore, using the conductance method, we find a low trap density of the Al_2O_3/IL/AlGaN interface for AlO_x and NiO_x ILs, in comparison with that of the Al_2O_3/AlGaN interface with no IL.

Keywords: AlGaN/GaN device, interfacial layer, threshold voltage control, vacuum level step, fixed charge