The realization of the GaAs-based metal-oxide-semiconductor field effect transistor (MOSFET) has been a subject of interest for many years. There remains an unfulfilled need for a good insulator to enable the GaAs-equivalent of Si complimentary metal-oxide-semiconductor (CMOS) technology. Amorphous insulator, flat insulator/semiconductor interface and low interfacial trap density are three key elements to the realization of such a metal-oxide-semiconductor (MOS) structure. Various oxides include SiO$_2$, Al$_2$O$_3$, MgO, Ga$_2$O$_3$, Gd$_2$O$_3$ and (Ga,Gd)$_2$O$_3$ on GaAs have been investigated by high resolution transmission electron microscopy (HRTEM), the data indicate that deposition of MgO, Al$_2$O$_3$ and Ga$_2$O$_3$ fail to yield a truly amorphous oxide; although deposition of SiO$_2$ result in an amorphous oxide, there lacks a transition layer between SiO$_2$ and GaAs. A correlation between high-low frequency capacitance-voltage (C-V) measurements$^3$ and physical interfacial structure property has been derived by HRTEM. A thin oxide epilayer$^4$ on GaAs has been identified and proposed as the key factor to solve the surface dangling bond problem, that is, the key to the attainment of a low interfacial density of states. On the other hand, SiGe and strained Si materials possess the merits of both higher electron and hole mobility comparing with the conventional Si one. SiGe devices have been vastly used in RF territory. In this report, interfacial information between nitride and SiGe will be addressed by HRTEM. One of the key issues among the technology of the growth GaN on Si substrate is the interfacial property between GaN/AlN as well as AlN/Si. High quality interface registry of AlN on Si substrate is the basic requirement to grow good quality subsequent GaN and InGaN layers. These interface phenomena will be illustrated and discussed by HRTEM technique as well.

REFERENCES