Formation of NiGe schottky contact with high thermal stability for high speed Ge-based transistors

Hyoungsub Kim, Kyung Park, Jae-Wook Lee, and Cheol-Woong Yang

School of Advanced Materials Science & Engineering, Sungkyunkwan University,
Suwon, Korea
TEL: 82-31-290-7363, FAX: 82-31-290-7371, E-mail: hsubkim@skku.edu

Within a couple of decades, the relentless increase of the device performance of the conventional Si-based CMOS(complementary metal oxide semiconductor) will be limited by the scaling problem of SiO_2 due to the significant increase of the leakage current by direct tunneling. Recently, as an alternative, Ge-based transistors having high carrier mobility have attracted a lot of interest with a help of the *deposition* technology of high-*k* dielectrics. In realizing Ge transistors, the formation of metal-germanide Schottky contact with high thermal stability is crucial to lower the source/drain contact and sheet resistances, and NiGe is known to be the best candidate among many possible metal-germanide systems.

In this presentation, we formed NiGe films by depositing Ni films on p- and n-type Ge substrates and by a subsequent annealing at various temperatures using an RTP (rapid thermal pressor) system. The microstructural evolution and thermal stability were investigated comparing with those in a similar NiSi formation process. In addition, the electrical properties, such as the sheet resistance and Schottky barrier height were also measured. Because the thermal stability of NiGe is resulted to be much worse than that of NiSi system, the Ni film was doped with 10 at% Ta atoms using a co-sputtering technique and its thermal stability was compared with that of Ni/Ge system. Through the addition of Ta atoms, Ni-germanide gain growth was retarded and the thermal stability was increased by 50°C. In order to understand the physical mechanism of the thermal stability improvement and also the microsctrucural evolution of $Ni_{1-x}Ta_x$/Ge system, cross-sectional TEM (transmission electron microscope) investigation was performed during the *in-situ* annealing using a specimen heating holder as a function of the annealing temperature.