[III-14]

In situ epitaxial growth of $TiSi_2$ on the Si(111)-7×7 substrate by coevaporation

Seung Shik Kim, Jai Yon Ryu, Sang Shik Oh, Chi Kyu Choi
Dept. Phys., Cheju Nat'l. Univ.

Jeong Yong Lee
Dept. Elect. Mater. Eng., KAIST

Byung Ryul Ryum
Semiconductor Tech. Div., ETRI

Kun Ho Kim
Dept. Phys., Gyeongsang Nat'l. Univ.

Epitaxial $TiSi_2$ films have been formed on Si(111)-7×7 or Si(100)-2×1 in terms of the coevaporation of titanium and silicon, with the atomic composition range, $0 \leq Si/Ti \leq 2$, and the *in-situ* annealing temperature range, 500~700°C, in the ultrahigh vacuum (UHV). It was shown that $TiSi_2$ films were separately formed into $TiSi_2$ and Si rich $TiSi_2$ layers on a Si substrate under the condition that the composition rate was given as Si/Ti=1 and the *in-situ* annealing temperature was 500°C. Its reaction mechanism was (Ti+Si)+Si=$TiSi_2$. Furthermore, it was also shown that, in the case where the composition rate was given as Si/Ti=2, high-quality $TiSi_2$ layer was formed as the sample with Ti+Si(1:2)/Si substrate was *in-situ* annealed at 500°C, whereas $TiSi_2$ layer structure was separately formed into atomic concentration layers of Ti+Si=1:2 and Ti+Si=1:3 at 750°C. Therefore, we have known that when the composition rate and the *in-situ* annealing temperature are, respectively, given as Si/Ti=2 and 500°C, $TiSi_2$ films are uniform without the agglomeration phenomena and their sheet resistances are 2.5 Ω/cm^2. The high resolution transmission electron microscope lattice image and transmission electron diffraction pattern show that C49-$TiSi_2$ is epitaxially grown on the Si substrate as the sample with Ti+Si(1:2)/Si structure at room temperature is *in-situ* annealed at 500°C for 10 min. in UHV. The $TiSi_2$/Si interface is somewhat incoherent, but the developed $TiSi_2$ crystallite is single crystal with matching face relationships of $TiSi_2[212]\|Si[011]$, $TiSi_2(120)\|Si(200)$, $TiSi_2(031)\|Si(111)$, $TiSi_2[013]\|Si[1\bar{1}0]$, and $TiSi_2(120)\|Si(111)$, $TiSi_2[\bar{2}1\bar{1}]\|Si[1\bar{1}0]$.