A study on the formation of ultra-thin $NiSi_2$ film and heteroepitaxial growth of epi-$NiSi_2$/Si(111).

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The ultra-thin $NiSi_2$ film was grown epitaxially on Si(111) substrate by depositing Ni film on Si(111)-7×7 surface and *in-situ* annealing in ultrahigh vacuum. The deposition was monitored by means of reflection high energy electron diffraction as a function of the thickness of Ni film. The $NiSi_2$ formation process was characterized using Rutherford backscattering and x-ray diffraction, and the interface structure was deterimined by high resolution transmission electron microscopy. The grown Ni film on the Si(111)-7×7 substrate at room temperature shows polycrystalline but highly oriented epitaxial type B $NiSi_2$ layer to the substrate at the Ni/Si interface. On vicinal(stepped) Si(111), different step structures form on the clean and Ni-diffused surfaces. The growth of $NiSi_2$ proceeds differently on the two step structures, both cases being different from growth on the planar surfaces. Specific type of step edges appears to favor formation of type B or type A $NiSi_2$. The best result for the growth of epitaxial type A $NiSi_2$ was obtained from the Ni(200Å)/Si(111)-7×7 sample which was annealed at 750°C for 20min.. A channeling minimum yield of this samples, $\chi_{min} < 2\%$, was measured using a glancing exit angle, and image of cross-sectional TEM shows that the silicide/Si interface are $NiSi_2$ $[01\bar{1}]//[01\bar{1}]$, $NiSi_2$ (111)//Si(111) without misorientation angle.