

On the inheritance of crystallographic texture during the nickel silicide solid-phase reaction.

F.A. Geenen^a, E. Solano^a, C. Mocuta^b, J. Jordan-Sweet^c, C. Lavoie^c, C. Detavernier^a

^a Ghent University, CoCooN, krijslaan 281/S1, 9000 Ghent, Belgium

^b Synchrotron SOLEIL, L'orme des Merisiers, Saint Aubin – BP 48, Gif-sur-Yvette, France

^c IBM T.J. Watson Research Center, Yorktown Heights, NY, USA

Nickel-based silicides are used to contact the source and drain regions of silicon-based transistors. The growth of the silicide on these regions occurs in direct contact with a single-crystal substrate, which can induce a preferred orientation of the silicide grains. This preferred orientation, or crystalline texture, can have a significant impact on the formation, stability and electrical properties of the silicide.

In this work, we have investigated the phase sequence of nickel silicides and their texture through *ex situ* X-ray diffraction pole figures as a function of annealing temperature and alloying species. 9nm Ni films on Si(001) substrates, optionally alloyed with 10% Co or Pt, were annealed up to 850°C and subsequently measured at the SOLEIL synchrotron. As such, we can observe that the crystalline alignment of the occurring silicides such as NiSi and δ -Ni₂Si is altered through alloying. Moreover, our measurements as a function of temperature provide clear evidence on texture inheritance of fiber and epitaxial orientations, i.e. that the crystalline alignment of a formed silicide phase can be related to the alignment of the preceding phase. We suggest that texture inheritance can significantly lower the interface energy, and by consequence lower the energetic barrier for phase formation and subsequent phase growth.

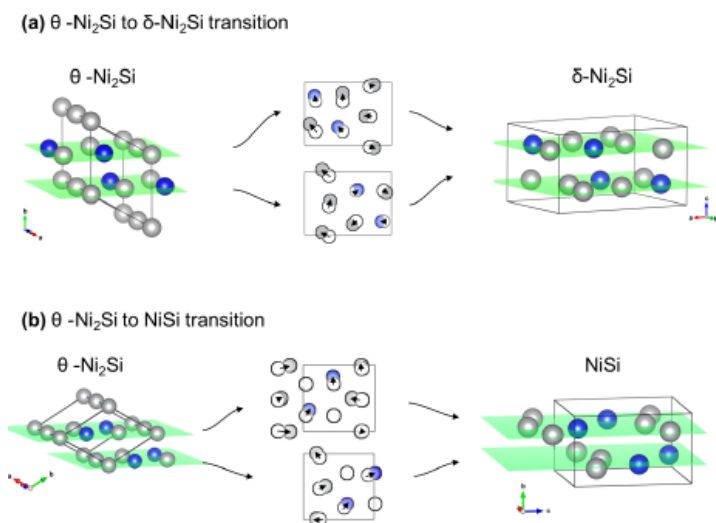


Fig. 1 - The transition from θ -Ni₂Si to either δ -Ni₂Si (a) or NiSi (b) involves only minimal atomic movement, and thus allows the inheritance of epitaxial alignments.

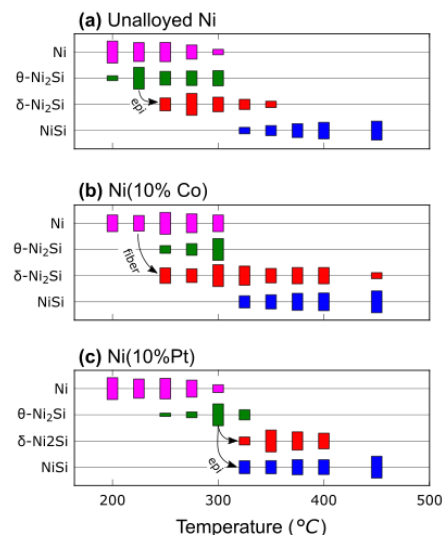


Fig. 2 – Overview of the observed silicides' diffraction intensities as a function of temperature for pure and alloyed Ni films. Arrows indicate examples of texture inheritance.