Effect of epitaxial alignment on electron transport from quasi-two-dimensional iron silicide α-$FeSi_2$ nanocrystals into p-Si(001)

© I.A. Tarasov, M.V. Rautskii, I.A. Yakovlev, M.N. Volochaev

Kirensky Institute of Physics, Federal Research Centre KSC, Siberian Branch of the Russian Academy of Sciences, 660036 Krasnoyarsk, Russia

E-mail: tia@iph.krasn.ru

Self-assembled growth of α-$FeSi_2$ nanocrystal ensembles on gold-activated and gold-free Si(001) surface by molecular beam epitaxy is reported. The microstructure and basic orientation relationship (OR) between the silicide nanocrystals and silicon substrate were analysed. The study reveals that utilisation of the gold as catalyst regulates the preferable OR of the nanocrystals with silicon and their habitus. It is shown that electron transport from α-$FeSi_2$ phase into p-Si(001) can be tuned by the formation of (001) — or (111) — textured α-$FeSi_2$ nanocrystals ensembles. A current-voltage characteristic of the structures with different preferable epitaxial alignment (α-$FeSi_2$(001)/Si(100) and α-$FeSi_2$(111)/Si(100)) shows good linearity at room temperature. However, it becomes non-linear at different temperatures for different ORs due to different Schottky barrier height governed by a particular epitaxial alignment of the α-$FeSi_2$/p-Si interfaces.

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