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Ion beam synthesis of epitaxial silicides: fabrication, characterization and applications

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Abstract

The technique of synthesizing buried epitaxial silicides by high-dose ion implantation and subsequent high-temperature annealing is reviewed. This technique, called mesotaxy, is at present the best way to produce high-quality buried epitaxial $CoSi_2$ in (100) Si and buried Î±- and Î²-$FeSi_2$ in (111) Si. In this report the experimental work of the first four years of mesotaxy is reviewed. The review begins with a brief introduction to epitaxial silicides, ion beam synthesis, and mesotaxy. This is followed by a discussion of the simulation of high-dose ion implantation. Next the microstructure during mesotaxial layer growth is described, including its dependence on implantation and annealing parameters. After the summary of the experimental results of the microstructure, particular emphasis is placed on discussing the growth process and developing a basic understanding of the mesotaxial process including nucleation and growth of precipitates during irradiation and coarsening, coalescence, and layer formation during annealing.

Properties of buried $CoSi_2$ and $NiSi_2$ layers in (100) and (111) Si are reviewed and discussed. Results on the formation of buried $NiSi_2$, $(Ni_{1-x}Co_x)Si_2$, α- and β-$FeSi_2$, $CrSi_2$ and $ErSi_2$ layers are also summarized. The first device applications are reported in which ion beam synthesis provides significant advantages over other techniques.

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