Co-silicide, Co(Ni)-silicide and Ni-silicide to source/drain contact resistance

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Future scaled technology nodes will require contact resistivity of about 10^{-7} Ω–cm^2[1]. Therefore, it is essential to minimize the contact resistance between the silicide and the source/drain junction, while contact dimensions are scaled down. Hence, there is an urgent need to accurately measure the silicide to source/drain contact resistance.

In this work, the contact resistance of Co-, CoNi- and Ni- silicides to 70nm As and B source/drain junctions is investigated using a set of dedicated test structures with silicided segments of varying lengths based on the Scott model of Transmission Line Structure (Figure1). The impacts of salicide process variables such as the silicide thickness, capping layers and silicidation thermal budget on the contact resistance are studied for each silicide.

In this experiment, the silicide to diffusion contact resistance is measured as a function of silicided segment length. The contact resistance saturates for long segments. The saturated contact resistance Ro multiplied by the width of the structure W is used to study the effect of varying silicide process parameters. Figure2 shows the effect of the second step of Co-silicidation on the contact resistance for 70nm-boron doped junctions. It can be observed that the contact resistance increases with increasing anneal time and temperature. We believe that the increase on contact resistance may be attributed to dopant deactivation, which decreases the active dopant at the silicide/silicon interface.

The Co-silicide is currently the mostly used silicide in the industry; a high thermal budget is needed to achieve smooth silicide/silicon interface and low leakage. This high thermal budget increases the contact resistance as can be seen in Figure2. In addition, the thermal budget of silicidation has to be reduced as much as possible to preserve the abruptness and low sheet resistance of the ultrashallow extension junctions.

It has been reported that alloying of Co films with Ni lowers the nucleation temperature of Co-disilicide. It is expected that the use of CoNi alloys will allow for a reduction of the thermal budget, which would be beneficial for contact resistance.

Significant reduction of thermal budget is obtained when Co-dicilicide is replaced by Ni monosilicide, which can be obtained at temperatures below 500ºC. The contact resistance should also be improved by the reduction of silicon consumption for NiSi. In addition, the lower barrier height for NiSi to p-type silicon should result in lower contact resistance for p-type transistors.

In this work silicide to diffusion contact resistance is compared for Co-, CoNi- and Ni-silicide process with low thermal budget.

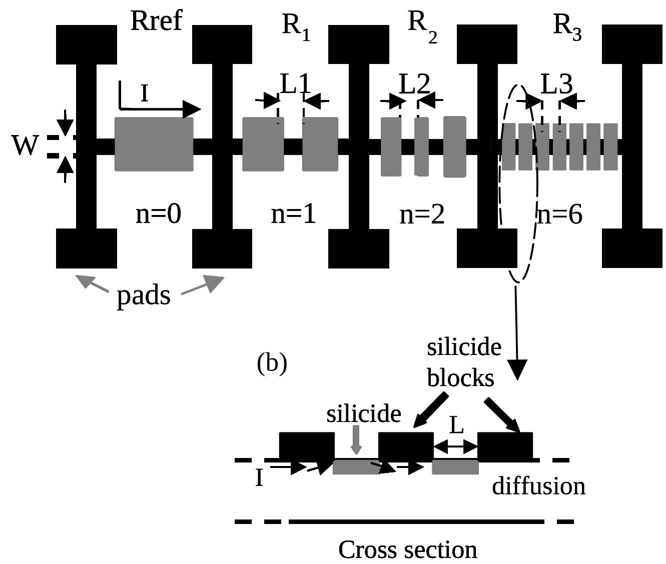

Figure1. Transmission line structure of alternated silicided and non-silicided areas
(a) Layout structure example
(b) Cross section through the structure

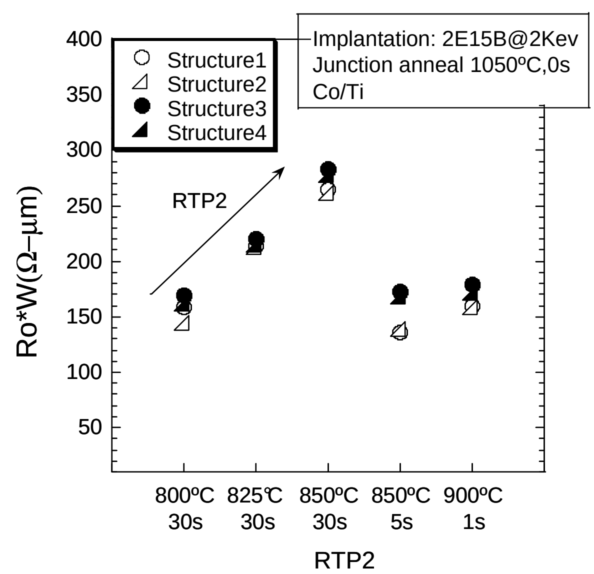

Figure2. Dependence of contact resistance on Co-silicidation time and temperature.
Structures 1 to 4 correspond to different geometrical dimensions (W, L) for the transmission line

References
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