**Introduction**

**Issues on Device Scaling**

CMOS devices have been scaled down, but that result in the following some issues.

- Some issues of Scaling: - Increasing of power consumption
  - Short channel effect & leak current
  - Increasing of parasitic resistance
  - Limit of processing

**Parasitic Resistance of Device**

Parasitic resistance become dominantly percentage of the total resistance [1].

Especially, in the case of NMOS, silicide and extension have a majority.

It need that reduction of channel’s damage and decrease of silicide’s resistivity.

**Purpose**

This study focused on parasitic resistance and set out to the following:

- Minimizing damage for channel
  - Reduction of roughness at interface and Ni diffusion
- Process of realizing high quality thin Ni silicide films
  - Reduction of resistivity of silicide film

**Experimental Procedures**

**Minimizing Damage for Channel**

- p-Si (100) substrate (2 cm x 2 cm)
  - SPM and 1% HF cleaning
  - Deposition by RF sputtering in Ar
  - Ni (3 nm) or stacked Si/Ni (8 sets)
  - RTA in F.G. for 30 min. @ 500 °C
  - SIMS

**Process of Realizing High Quality Thin Ni Silicide Films**

- n-Si (100) substrate
  - SPM and 1% HF cleaning
  - Deposition by RF sputtering in Ar or Kr
  - NiSi₂ formed by Kr sputtering was compared to that formed by Ar sputtering.

**Results & Discussions**

**Minimizing Damage for Channel**

Compared NiSi₂ by only Ni (3 nm-thick) layer on p-Si to stacked NiSi₂ by Si/Ni (8 sets) multi-stack on p-Si.

Ni diffusion could be suppressed by the Ni silicide formed stacked Si/Ni.

**Process of Realizing High Quality Thin Ni Silicide Films**

It reported that it is difficult for Kr gas to entrap into the sputtered film than Ar gas [2].

So, in this study, Ar gas was changed with Kr gas and the influence investigated.

Stacked NiSi₂ formed by Kr sputtering was compared to that formed by Ar sputtering.

The resistivity of stacked NiSi₂ by Kr decrease than that by Ar at low temperature region.

The value of resistivity was equivalent to bulk one, which was about 34–50 μΩ-cm (that is illustrated by the green line in upper right figure and by the green shaded area in lower right figure).

**Conclusion**

Minimizing damage for channel and process of getting low resistivity film was investigated.

- Ni diffusion could be suppressed by the Ni silicide formed stacked Si/Ni and channel damage was reduced.
- By changing sputtering gas with Kr from Ar, resistivity of bulk NiSi₂ was obtained. It was considered that Kr gas entrapped into the film was lower than Ar.

**Reference**
