FIB induced damages of SEM/TEM samples of semiconductor devices

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Goal of the investigation:

- Determination of sample damage during Pt-deposition depending on ion beam current
depending on deposition mode (already running dep. process)
- Comparison of E- and I-beam assisted Pt-deposition
- Assessment of I-beam induced damage on TEM samples

Second Pt-deposition for TEM lamella preparation

TEM cross sections of I-beam Pt-deposition

Layer stack:
- 2. Pt - deposition
- 1. Pt - deposition
- mixed layer
- amorphous layer - app. 40nm
- Silicon

TEM cross section of Pt-deposition box - 150pA/60 sec

Box has been moved during deposition

TEM cross section of Pt-deposition box - 70pA/120s
TEM cross sections of e-beam assisted Pt-deposition
Area was etch by the ion beam 350pA / 2min

EFTEM Oxygen map of amorphous region E- vs. I-Beam dep.

Influence of sample tilting on TEM lamella profile (silicon)
sample tipping angle: 0° sample tipping angle: ± 1.2°

Influence of sample tilting on near-surface amorphization of Si
sample tipping angle: 0° sample tipping angle: ± 1.2°
conventionally prepared sample: Ar+ ion-milling at 3.5 kV tipping angle of ion gun: 5°
Ga profiles
Summary:

Ion beam assisted Pt-deposition on Silicon leads to
- an amorphous layer of about 40nm,
- a mixed layer of about 30nm containing Si, Ga, C, Pt.

The layer thicknesses are independent on I-beam current (70, 150, 350 pA).

No sample damage was observed for the E-beam assisted deposition.

I-beam induced damage (amorphization) on side walls of TEM lamellas is in the range of 20 nm.