EVALUATION OF COMMERCIAL ULTRA-THIN SOI SUBSTRATES USING CONFOCAL LASER INSPECTION SYSTEM

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An SOI active layer has recently been moved into the domain of 50-nm or less ultra-thin film. The technology required to evaluate such ultra-thin SOI materials is typically more difficult than that for thicker SOI substrates due to the unfavorable interference of the irradiated light used as the evaluation probe and the limited volume of evaluated layer. However, in responding to the requirement for ultra-thin SOI substrates to use in the fabrication of future generation of CMOS devices, the development of an evaluation technology is indispensable to improve SOI quality. The results are presented here of an evaluation of commercial ultra-thin (50-60nm in superficial Si layer thickness) SOI substrates performed by using a wafer inspection system equipped with confocal laser optics. The effectiveness of the system for evaluating ultra-thin SOI substrates is also discussed.

In the experiment, three bonded SOI substrates obtained from three vendors and five SIMOX wafers obtained from the different three vendors were evaluated using a wafer inspection system called MAGICS that was equipped with laser confocal optics. The system can evaluate defect distribution and provide laser confocal images in conjunction with their position on the wafer. The system also allows for the position that corresponds to the observed defects to be marked, therefore, making it possible to prepare the samples for TEM observation using FIB.

Figure 1 shows the defect distributions observed in two bonded wafers formed using different processes. Obviously, the distributions were opposites. Bonded-A had a higher defect density at the wafer edge than at the wafer center, while the defect density in SIMOX-B is the opposite. Some laser confocal images of defects observed in Bonded-B are shown in Fig. 2. The images of defects might correspond to surface scratches, voids, defect clusters, etc.

Figure 3 is the defect distributions measured from two SIMOX wafers formed using the same process but obtained from different vendors. In both cases, the defect distributions were similar, the density changed from one side to the other, although the number of detected defects appeared to be different. An example of an observed defect is shown in Fig. 4, with both a laser confocal image and a TEM cross section. It is obviously that the observed image was a void, that is , the SOI film was missing. The void in BOX might have been introduced or enlarged during the chemical treatment after SOI formation during the etching process using HF-solution.

In conclusion, commercial ultra-thin SOI substrates were evaluated by using a laser confocal inspection system. Comparing to results form the bulk Si observation, the SOI substrates generally showed a high background signal level as well as high-density defects, such as scratches, small pits, large voids, and dislocations. The defect distribution and images of individual defects were presented. The most serious defect observed was the voids for both the bonded SOI and the SIMOX samples.

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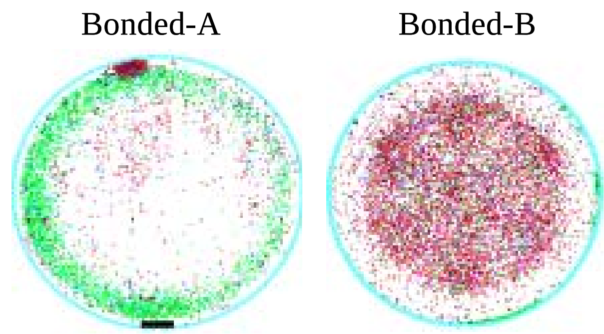

Fig. 1 Defect distribution observed in boded SOI wafers.

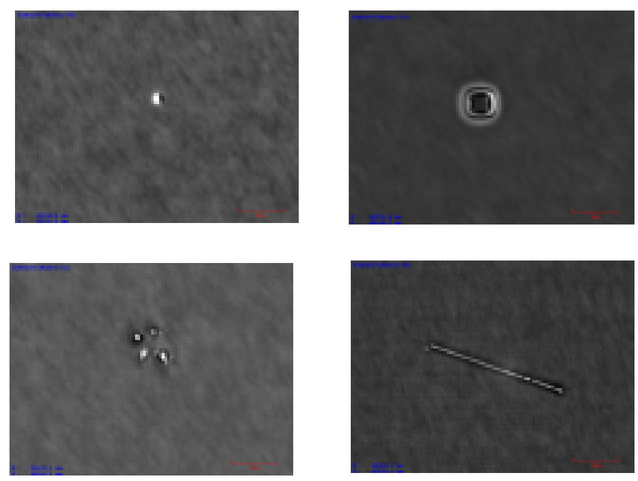
Fig. 2 Laser confocal images of defects observed in boded SOI wafer.

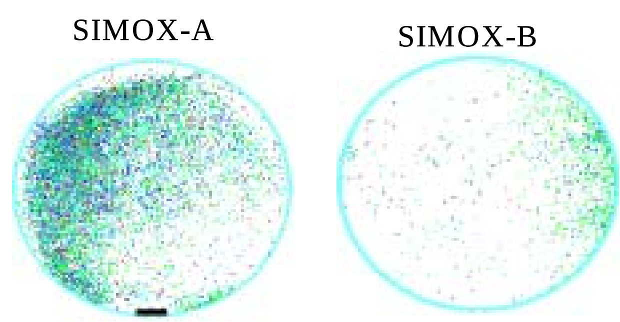

Fig. 3 Defect distribution observed in SIMOX wafers.

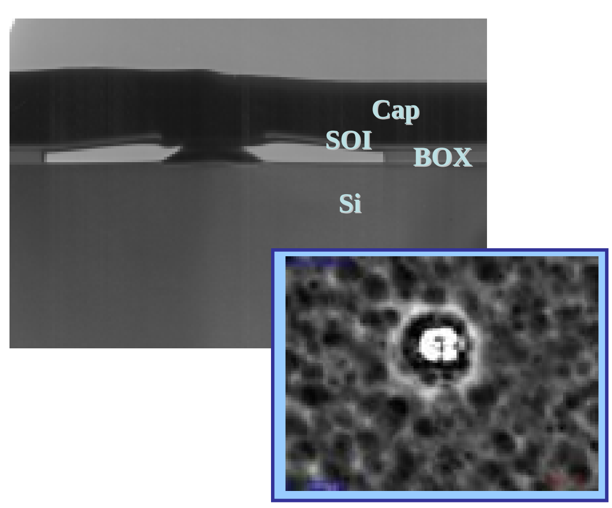

Fig. 4 TEM and laser confocal images of defect observed in SIMOX wafer.