

11th International "Hiroshima" Symposium on the Development and Application of Semiconductor Tracking Detectors (HSTD11) in conjunction with 2nd Workshop on SOI Pixel Detectors (SOIPIX2017) at OIST, Okinawa, Japan

Contribution ID: 78

Type: POSTER

Application of a monolithic SOI pixel detector to evaluation of strength of industrial materials

Sunday 10 December 2017 21:20 (1 minute)

One of the authors, Sasaki, developed a new equipment for X-ray stress measurement in 2011 which was based on so-called the $\cos\alpha$ method, and showed that the weight of the equipment, the occupied space and the measuring time were advanced to about 1/20, 1/15, and 1/10 respectively compared with the ordinary machines. The accuracy of the stress obtained was also found to increase because of the fact that the acquisition number of X-ray diffraction data is about 70 times more than that obtained with the ordinary machines. An image plate (IP) was used in the equipment as a two-dimensional X-ray detector, and it takes about 30 to 120 seconds for X-ray exposure and about 30 seconds for the data analysis. In this study, a monolithic SOI pixel detector (SOI detector) was used instead of an IP in order to reduce the measuring time of the DS-ring. The SOI detector was developed by one of the authors, Arai, which is made from a silicon wafer. In this study, the authors succeeded in measuring the stress of a steel sample with $\text{CrK}\alpha$ radiation. It was found that it takes one second for stress determination which is about 1/60 shorter than the equipment with an IP. The outline of the both equipment, IP-use and SOI-use X-ray stress measurement machines, as well as their comparison will be showed with some experimental data in this paper.

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Session Classification: POSTER

Track Classification: SOI detectors