15C/2006G057

Characterization of Strained Si Wafers by Synchrotron X-ray Topography

Takayoshi SHIMURA*[1], Kohta KAWAMURA[1], Masahiro ASAKAWA[1], Heiji WATANABE[1], Kiyoshi YASUTAKE[1] and Atsushi OGURA[2]
[1]Osaka University, 2-1 Yamadaoka, Suita, Osaka 565-0871, Japan
[2]Meiji University, 1-1-1 Higashimita, Tama-ku, Kawasaki 214-8571, Japan

Introduction

Strained Si technology has been expected as one of the methods to improve the performance of MOSFETs. Devices which have a strained Si channel are used as high speed MOSFETs, because carrier mobility in strained Si is higher than that in relaxed Si.

One of the ways to fabricate the strained Si devices is to employ strained Si wafers, which have a strained Si layer with thicknesses of typically ~20nm on the surface of the wafer. The advantages of this way are relatively large strain and the applicability of the ordinary device fabrication processes. However, the crucial problem is that the crystal quality of the strained Si wafers is poor. In order to solve this problem, it is important to evaluate the crystalline quality of the strained Si wafer.

Synchrotron radiation (SR) X-ray topography is an effective method for characterizing imperfections of crystalline materials. It provides us the ununiformity of the crystal quality of the wafer [1,2]. The information are important to understand the crystalline quality of the wafer properly and to improve wafer fabrication techniques. In this study we characterized the strained Si wafers by using X-ray topography.

Experimental

We employed the strained Si wafers, of which the strained Si layer was epitaxially grown on the SiGe-on-Inulator (SGOI) wafer. The SGOI wafers were made by two methods. One of them is the bonding method. Relaxed SiGe layer was bonded on the Si substrates with a surface oxide layer. The other one is Ge-condensation method. The relaxed SiGe layer was made by oxidation of the SiGe layer of relatively low Ge concentration grown on silicon-on-insulator (SOI) wafers.

Synchrotron X-ray topography experiments were carried out at the BL-15C of Photon Factory, KEK, Tsukuba, Japan. The asymmetric 115 reflection in Bragg case with a glancing angle of ~1 degrees were used. The X-ray film used was Fuji IX-100. The SR beam was monochromatized to 20keV using a Si (111) double-crystal monochromator and a square beam of 25 (horizontal) × 1 (vertical) mm^2 size formed by a four-quadrant slit was irradiated onto the sample from the strained Si layer.

Results

Fig.1 shows X-ray topographs using the reflection from the Si substrate. We can observe the streak contrast, indicating the existence of the strain even in the Si substrate, propagating through the buried oxide layer.

References

[1] K. Fukuda et al., Jpn. J. Appl. Phys. 43 1081 (2004).
[2] T. Shimura et al., Eur. Phys. J. Appl. Phys. 27 439 (2004).

* shimura@mls.eng.osaka-u.ac.jp

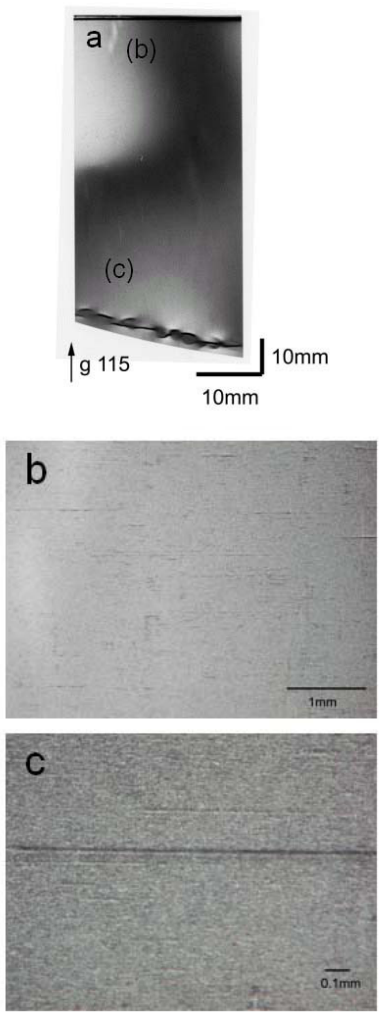

Fig.1 X-ray topographs of the strained Si wafers. They were taken using the reflection from the substrate. (b) and (c) are the enlargements at the positions of (b) and (c) indicated in the figure (a), respectively.