Estimation of Lattice Structure of Strained-Si Wafers Using Highly Parallel X-Ray Microbeam (I)

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We demonstrate the estimation of lattice structure of commercially available strained-Si wafers by high-resolution X-ray diffractometry using a highly parallel X-ray microbeam [1].
A strained-Si wafer has 3 layers of strained-Si, constant composition of SiGe (CC) and graded composition of SiGe being epitaxially grown on a [001]-oriented Si substrate. The thicknesses of these layers are 17.5 nm, 3.2ìm and 2.4 ìm, respectively.

Diffracted X-rays from extremely thin strained-Si layer could be detected by use of the X-ray microbeam. The intensity distribution maps in reciprocal lattice space show that the lattices in strained-Si, and CC layers are greatly misarranged to the Si substrate. However, the equi-tilt maps, which are intensity distribution measured under fixed rotation angles of the sample and an analyzer crystal, reveal that the lattice tilt variation of these layers is not random but roughly aligned in mainly its crystallographic orientation parallel to one of the two <110> directions. Furthermore, it would be considered that the crystallographic orientation of lattices in the strained-Si layer matches to that of the underlying CC layer.

[1] Matsui J., et al., *proceeding of the 4th international symposium on advanced science and technology of Si Materials*, 2004, 237.

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