Materials Science

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Micro X-ray diffraction analysis of meso-structured silica thin films with a single-crystalline 3D hexagonal structure

Takashi NOMA*[1], Taihei MUKAIDE[1], Kazuhiro TAKADA[1], Hirokatsu MIYATA[1], Atsuo IIDA[2]
[1]Canon Research Center
[2] KEK-PF, Tsukuba, Ibaraki 305-0801, Japan

Introduction

Self-assembled surfactant-templated silica thin films exhibit two-dimensional (2D) hexagonal, three-dimensional (3D) hexagonal, or 3D cubic mesostructures. A sunchrotron x-ray microbeam has been utilized for analysis of these materials.

Experimental

We prepared mesostructured silica thin films with a single crystalline 3D-hexagonal structure. The silica thin films were obtained on a silica glass substrate using a rubbing-treated thin polyimide coating on the substrate. The silica film was formed through a slow epitaxial growth of a self-organized mixture of hydrolyzed silicon alkoxide and the surfactant under acid conditions.

The x-ray diffraction experiments were performed at the Photon Factory on beam line 4A. Synchrotron X rays were monochromated with a W-Si multilayer monochromator. X rays tuned at 8 keV were used. Using the Kirkpatrick-Baez system consisting of a pair of elliptical mirrors formed the x-ray microbeam. The mirrors were made of platinum-coated fused quartz. The beam size was about 4 x 4 μm^2 at the sample position. The samples were mounted on XZ translation stages that were mounted on a ω-rotation stage with a vertical rotation axis and a ϕ-rotation stage with a horizontal rotation axis. The incidence angle of X-ray microbeam was regulated by the ω axis. Tow-dimensional diffraction patterns were collected by a CCD X-ray detector with image intensifier.

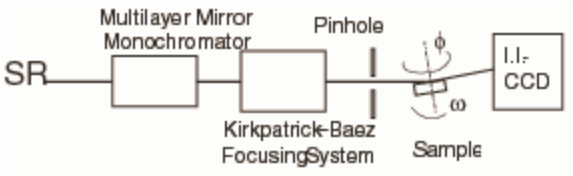
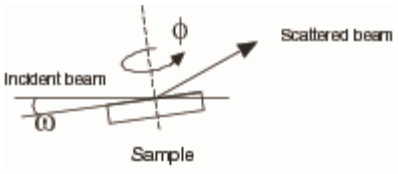
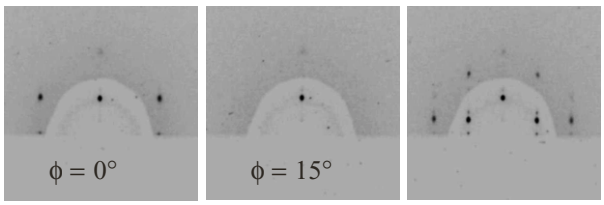


Fig. 1

Results

X-ray diffraction patterns are shown in Fig.2. Figure 3 is a schematic illustration of the single crystalline 3D hexagonal structure on the substrate.





(a) **(b)** **(c)**

Fig.2

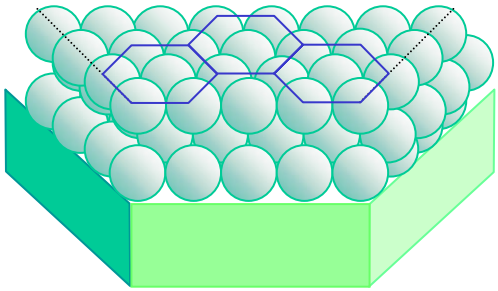


Fig.3

References

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* noma.takashi@canon.co.jp