



実験報告書様式(一般利用課題・成果公開利用)

(※本報告書は英語で記述してください。ただし、産業利用課題として採択されている方は日本語で記述していただいても結構です。)

 Experimental Report 	承認日 Date of Approval 2016/07/12 承認者 Approver Dai Yamazaki 提出日 Date of Report 2016/07/04
課題番号 Project No. 2014B0002 実験課題名 Title of experiment Feasibility test of coded mask for efficient neutron reflection projection capturing to realize 3D visualization of multilayerd thin films 実験責任者名 Name of principal investigator Kenji Sakurai 所属 Affiliation National Institute for Materials Science	装置責任者 Name of Instrument scientist D. Yamasaki 装置名 Name of Instrument/(BL No.) BL17 実施日 Date of Experiment March 30- April 1, 2015, November 6-9, 2015, a part of February 24-27, 2016 (total 6 days)

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。(適宜、図表添付のこと)
 Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.
A patterned layered thin film (coated by Ni and Ti on Si wafer)

2. 実験方法及び結果 (実験がうまくいかなかった場合、その理由を記述してください。) Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.
The present work was done after the success of feasibility test (2013A0227 and 2014A002) in retrieving neutron reflection projection from inhomogeneous thin film samples. We have developed high-resolution coded masks which are equipped with 31 and 47 slots, aiming the spatial resolution of 1 mm and 0.7 mm, respectively. We also upgraded the instrument to obtain the neutron reflectivity in further reliable and reproducible ways. The minimum angular step of our new goniometer is 1/90,000 deg. The instrument is equipped with some other additional alignment mechanism to find the best neutron reflection condition as well. Though we did not use the reflectometer in the BL17 any more, we still needed the ³ He detector and the 2theta axis. In the previous trials (2014A002), we measured and discussed the line profiles of the projections from only two angles, 0 and 90 deg. During the present experiments, we decided to collect all projection data from all angles for 180 deg rotation. The number of TOF reflectivity data became 558 and 846, for 31 and 47 slots of coded mask, respectively. By mathematical decoding we obtained many reflection

2. 実験方法及び結果(つづき) Experimental method and results (continued)

projections. In the end, we were successful in reconstructing the reflection image from such projections. The good point of the use of white neutron from the J-PARC is that the finally obtained data is not black-and-white but color image. As each color (wavelength) corresponds to each q , the analysis can help to understand the buried layers and interfaces with more information than X-ray reflectivity imaging. In the later stage, thanks to the assistance of the beamline scientists, we were able to change the chopping condition to widen the wavelength range, from 2.2-9.67Å to 1.03-8.7Å. The ratio between the longest and the shortest wavelength is extremely important to extract the structural information efficiently by the same imaging procedure. This time the ratio has been improved nearly twice.