Preliminary masurement of hydrogen content absorbed in Pd using neutron composite mirror

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Preliminary experiments on the measurement of hydrogen content in Pd using composite mirrors was performed. The composite mirror consists of neutron a half-mirror, a gap layer, and a second half-mirror. The gap layer is made of target material Pd. The half-mirrors are Ni/Ti multilayer with the refelctivity of about 50%, Neutrons which enters the composite mirror, is partly reflected by the first half-mirror and the remaining neutron goes through the gap layer and is reflected by the second half-mirror.

Between these two reflected neutrons, phase difference ϕ is introduced by the gap layer. $\phi = 2nD\sin\theta/\lambda$, where n, D are the neutron refractive index and the thickness of the gap layer, and *theta*, λ are neutron incident glancing angle and neutron wavelength, respectively.

In the reflectivity curve of the composite mirror interference fringes due to the phase difference is observed. When D or n changes, the interference fringe is shifted. In our experiment, from the shift of the interference fringes we detect the change in n and D of the gap layer material Pd due to hydrogen absorption.

In the present experiments, two composite mirrors are arranged in $(+-)$ configuration, in order to increase the contrast of the interference fringes.

The composite mirrors were fabricated with vacuum evaporation method at KURRI. The number and mean thickness of Ni and Ti layers in a half mirror are 6 and 10nm, respectively. The thickness of the gap layer is 100nm. During the evaporation of top half-mirror, a mesh mask is placed over the composite mirror in order to expose partially the bare Pd gap layer.

Neutron reflectivity measurements were performed at C3-1-2-2 (MINE) beam hole of JRR-3M reactor in JAEA. Neutron wavelength and the wavelength resolution is 0.88nm and 2.7%.

The neutron reflectivity result is shown in Fig.1. Horizontal and vertical axis represent neutron incident angle to the second composite mirror and the reflectivity, respectively. The broad peak from 0.9deg to 1.5deg is due to the half-mirror, and small interference fringes over the broad peak are caused by the gap layer. The measured result is well reproduced by the calculated result.

In the present experiment, hydrogen absorption was not done because of technical reason. Experiments using hydrogen is planned in the beginning of the next budget year.

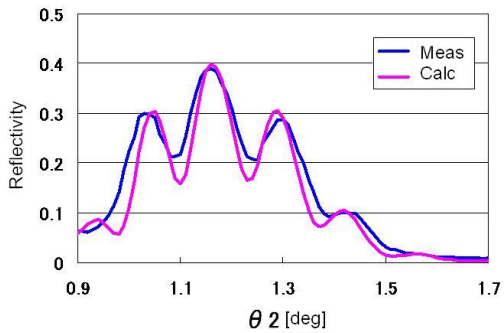

Fig. 1. Neutron reflectivity of the composite mirrors in $(+-)$ configuration.