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。）

<table>
<tr><td>MLF Experimental Report</td><td>提出日 Date of Report
2018/1/19</td></tr>
<tr><td>課題番号 Project No.
2017B0106
実験課題名 Title of experiment
Imaging of hydrogen localized in aluminium
実験責任者名 Name of principal investigator
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Takenao Shinohara
装置名 Name of Instrument/（BL No.）
BL22
実施日 Date of Experiment
2017/11/20-21</td></tr>
</table>

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.
4N pure aluminum Al-10%Zn-1%Mg alloy 3N pure Palladium

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.

Experimental methods

Neutron transmission imaging was performed in order to visualize the hydrogen distribution in the metal. The experiment was conducted at BL22 RADEN. L/D value was set to 230, and neutron energies were tuned to 2-3 Å and 5-13.5 Å by the disc chopper. Cooled CCD (2k x 2k pixels) and ZnS / ^{6}LiF scintillator were used for the detector, and the field of view was 30 x 30 mm. Specimens are pure aluminum, Al-Zn-Mg alloy, and pure palladium. Hydrogen-charged and hydrogen-uncharged specimens were used to the imaging.

Results

Fig. 1 shows the neutron transmission images of wavelengths (a) 2-3 Å and (b) 5-13.5 Å. The contrast of the image is normalized by the direct beam and corresponds to the neutron transmittance. In the palladium after hydrogen charging, the contrast changed darkly from the edge of the specimen toward the center.

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

This change in contrast means a decrease in neutron transmittance, which suggests that the hydrogen content inside the specimen is high. It has been considered that hydrogen near the surface was desorbed before imaging.

On the other hand, contrast change with and without hydrogen is limited in the aluminum. This is due to aluminum has a significantly low equilibrium hydrogen solubility compared with palladium. The attenuation coefficients of aluminum were evaluated using the average wavelength from Fig. 1. As a result, the change of attenuation coefficients is corresponding to the difference in the wavelength range. Furthermore, when estimating the hydrogen content from the attenuation coefficients, the hydrogen content in aluminum evaluated from two imaging was both on the order of mass ppm. Fig. 2 shows the results of thermal desorption analysis of the hydrogen-charged aluminum. Solute hydrogen was the order of mass ppm. It has been reasonably inferred that the slight contrast change of aluminum with and without hydrogen in Fig.1 is the influence by hydrogen.

Thus, hydrogen was detected in both palladium and aluminum in the present neutron imaging. The author plan to extend to tomographic observation and aim at visualization of 3D hydrogen distribution in the further works.

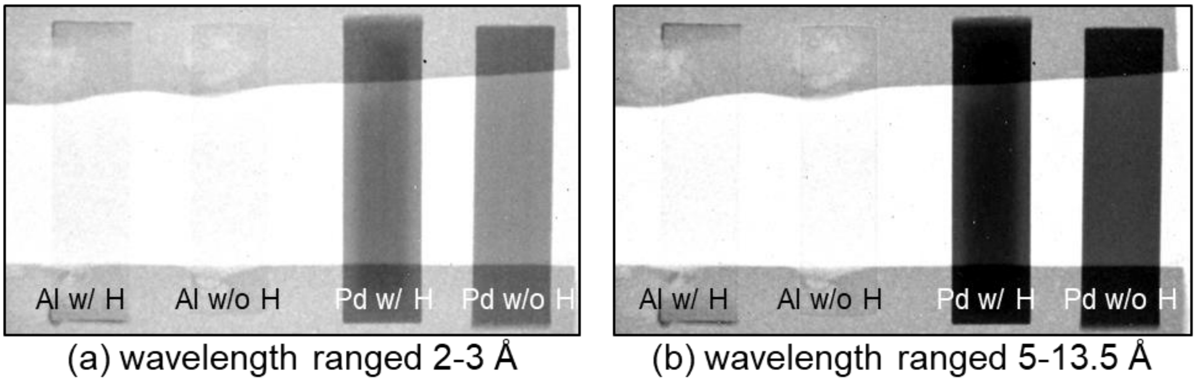

Fig. 1 Neutron transmission images at wavelength ranged (a) 2-3 Å and (b) 5-13.5 Å

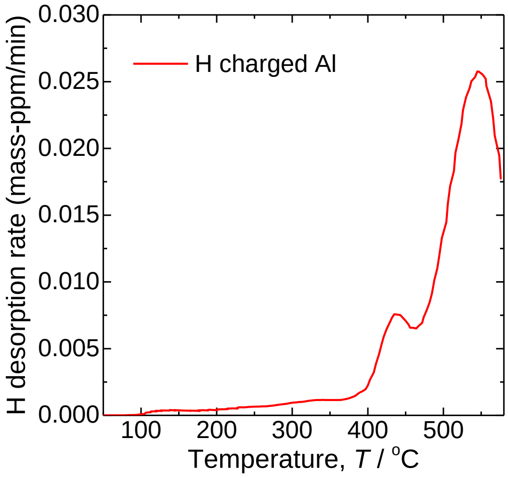

Fig. 2 Hydrogen desorption curve of hydrogen charged aluminum