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。 ）

MLF Experimental Report	提出日 Date of Report Sept 22nd, 2014
課題番号 Project No. 2014A0087 実験課題名 Title of experiment Measurement of stress distribution along rebar in reinforced concrete using pulsed neutron diffraction 実験責任者名 Name of principal investigator Hiroshi Suzuki 所属 Affiliation Japan Atomic Energy Agency	装置責任者 Name of responsible person Kazuya Aizawa, Stefanus Harjo 装置名 Name of Instrument/（BL No.） TAKUMI/ BL19 実施日 Date of Experiment June 22nd – June 26th, 2014

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 ferritic steel deformed-bar (bamboo rebar) with 9.53 mm nominal diameter was embedded in a cylindrical concrete with 51 mm in diameter and 460 mm in length. The embedded depth of the rebar was 430 mm, and un-bonding region with 110 mm in length was artificially introduced. Three different corrosion rates including no corrosion were provided using the electrical corrosion method. The current with 20.16 Ah in total was applied to the specimen for 12 days (lower corrosion rate), providing corrosion products of 219 mg/cm^2 in calculation, and that with 34.56 Ah in total was applied to the specimen for 24 days (higher corrosion rate), providing 375 mg/cm^2. Very large cracks were observed for the specimen with higher corrosion rate because of swelling of corrosion products while the specimen with lower corrosion rate has only small cracks.

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 engineering diffractometer, TAKUMI, installed at BL19 in MLF (Materials and life Science Experimental Facility) of J-PARC (Japan Proton Accelerator Research Complex) was utilized. The reinforced concrete specimen mounted in the loading device was set up on the XYZθ positioner, oriented 45° to the incident beam. The gauge volume defined by the incident gauge definition slit and radial collimators was $5\times5\times10$ mm^3. The high intensity mode with low instrument resolution designed to be $\Delta d/d$=0.4 was selected, and diffraction patterns from the deformed rebar over the range of *d*-spacing from 0.5 to 2.7 Å were measured in the axial and lateral directions simultaneously using both detector banks installed at ±90°. The average lattice constants in these directions were determined by multi-fitting procedure. The strain distributions were measured at 10 mm intervals along the deformed rebar under different tensile loadings, i.e. approximately 30 MPa, 125 MPa and 250 MPa.

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

Figure 1 shows comparison of the axial stress distributions along the embedded rebar with three different corrosion rates at 250 MPa applied loading. The stress distribution for no corrosion specimen shows similar result to the previous work published in [1] (2012B0058), i.e. the tensile stress increases towards the end of the bonding region (*x*=0) in the anchorage region. The stress distribution for the specimen with lower corrosion rate is similar to the no corrosion specimen, but the compressive stresses in the bonding region decreases probably due to stress release that may be caused by the corrosion products. The bond resistance for the lower corrosion specimen, determined by the slope of the stress distribution in the anchorage region, is higher than that for no corrosion specimen. Corrosion products may improve mechanical bonding performance between concrete and rebar. Since it was insufficient to eliminate bonding in the un-bonding region for the specimen with higher corrosion rate, the applied stress at *x*=0 mm is 150 MPa, lower than applied loading, 250 MPa. The stress distribution for the specimen with higher corrosion rate is quite different from others. An increase in the tensile stress is observed around large cracks (approximately from *x*=20 mm to 200 mm), showing bond deterioration. However, the rebar could not be slipped out from concrete because the anchorage region was left from *x*=200 mm. As described above, the change in the stress distribution with corrosion rate can be assessed by measuring the stress distribution using neutron diffraction. The neutron diffraction is expected to bring new knowledge on the bond deterioration mechanism due to corrosion.

Reference

[1] H. Suzuki, K. Kusunoki, Y. Hatanaka, T. Mukai, A. Tasai, M. Kanematsu, K. Kabayama and S. Harjo, Meas. Sci. Technol. 25 (2014) 025602 (8pp).

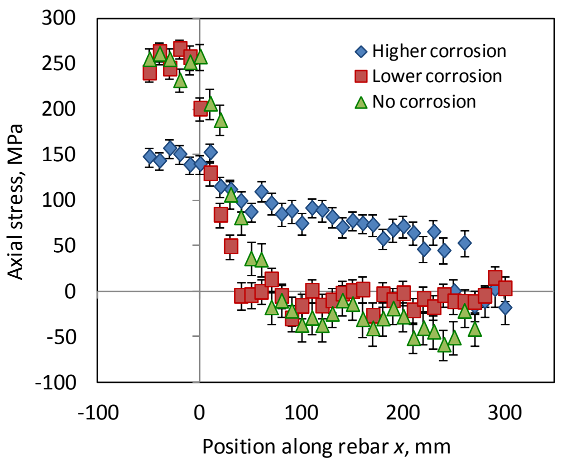

Fig. 1 Comparison of axial stress distributions along the embedded rebar with different corrosion rates under 250 MPa loading.