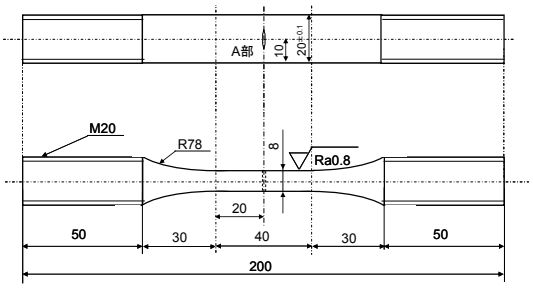
（ ※本報告書は英語で記述してください。ただし、産業利用課題として採択されている方は日本語で記述していただいても結構です。 ）

MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2014A0140 実験課題名 Title of experiment Measurement of residual strain profile in front of the fatigue crack after excessive loading 実験責任者名 Name of principal investigator Kenji Kikuchi 所属 Affiliation Ibaraki University	装置責任者 Name of responsible person Stefanus Harjo 装置名 Name of Instrument/（BL No.） 19 実施日 Date of Experiment 24 April

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.

Sample used in the experimnet is a solution-annealed austenitic stainless steel and chemical composition is Fe70-Ni15-Cr-15. Specimens are a type of center-cracked plate with a size of 8x20x200mm (Fig), a small bar with 3mm in diameter, and rectangular type samples. They are to be tested for residual strain profile measurement after loading, for acquisition of d-o value in order to define strains, and for inspecting alpha prime transformation from austenitic microstructure due to cold-work process, respectively.



Center nitched specimen was preloaded in order to get fatigue crack ahead of the the notch and then over-loaded 1.3 times more than o.2% proof stress level for tension and under-loaded for compression at the same level with tension.

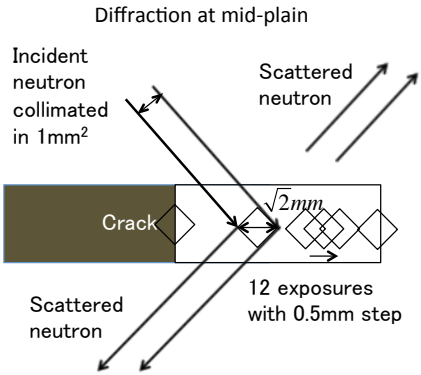
2. 実験方法及び結果（つづき）Experimental method and results (continued)

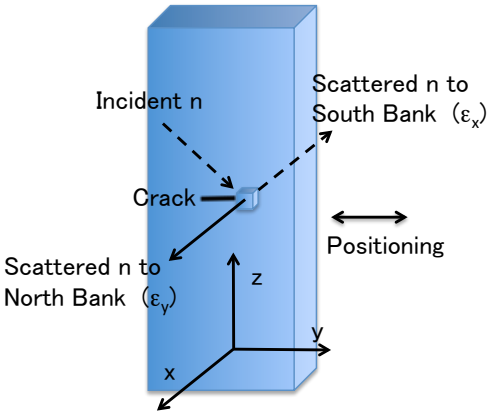
2. 実験方法及び結果（実験がうまくいかなかった場合、その理由を記述してください。）

Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.

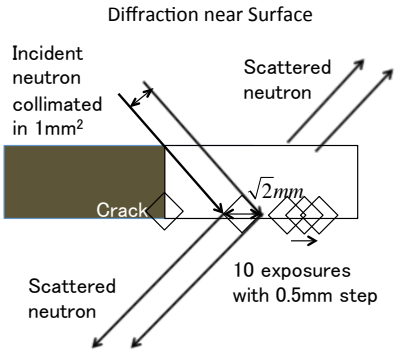
Eperimental:

Stand-alone specimen was setup on the cylindrical bar at the center position, exposed by neutron beams through 1mm collimator at the injection side, and detected by the two data banks, which were called south bank at the right hand side and north bank at the left hand side. Diffracted beams were collimated through 1mm slits. Beam exposure time duration was designed to forty minutes for every twelve scanning points. Neutron beams was exposde at the mid-plain of the specimen plate firstly as shown in the figure below.

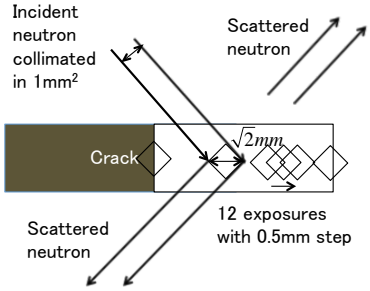


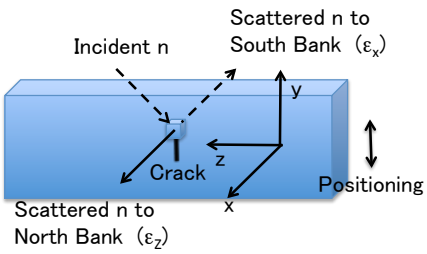


After a completion of the first measurement the position control was fit to the neutron measurement at surface volume as shown in the right figure. This measurement was done to compare the inner part and near surface one. The number of measurement volume was decdreased to nine for time economy.



Another twelve scanning points measurement followed the previous measurement but after rotating the specimen by 90 degree as shown in the figure below. This rotation enabled to get three dimentional strain components, ε_z-ε_x and ε_x-ε_y.



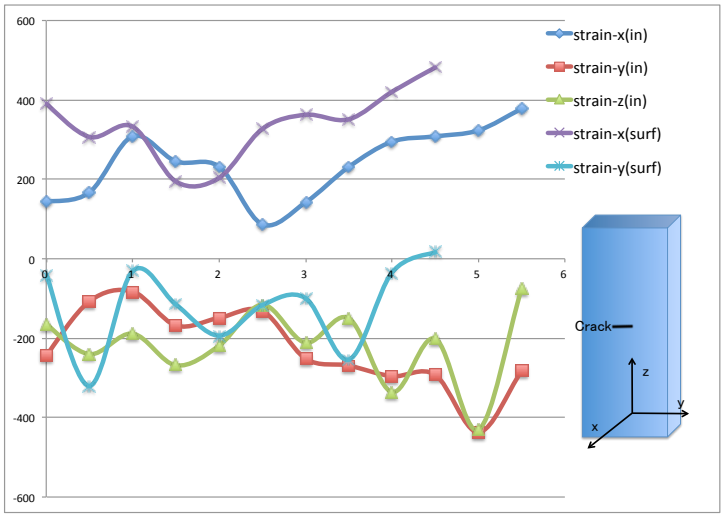


A bar type specimen was used to determine d-o strain.

Results:

We had data stored in the two databanks and refined by Z-Rietveld. Plot showed strain profile in the frame of distance from the crack tip, mm, and strain, μ. Strain-x, -y and -z correspond to the direction of specimen thickness, the specimen width and loading, respectively. Strains are defined by the next equation.

$$\varepsilon = \frac{d - d_o}{d_o}$$



Findings are:

1) Sign of strains to the plate thickness direction is tension, and absolute strain level at the surface is larger than that in inner part.

2) Sign of strains to the plate width direction is compression. It was observed null at y=4mm at near surface while negative strains are still remained in mid-plate.

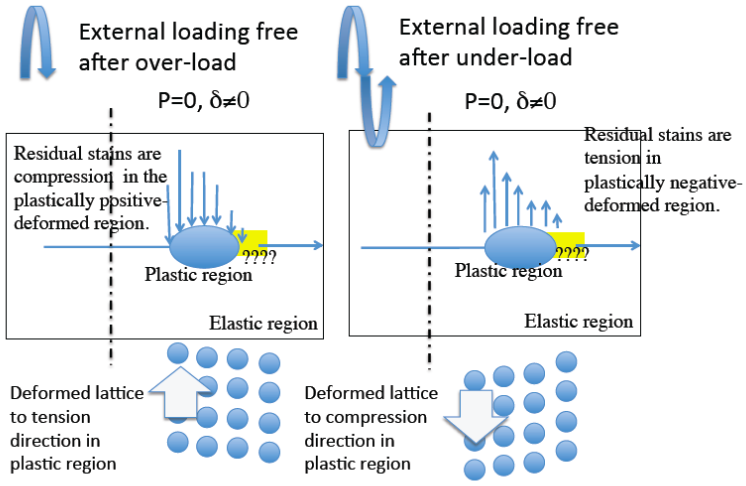
3) Sign of strains to the axial direction is compression.

From the sign of the residual strains it is concluded that specimen was squeezed to the plate thickness direction and elongated to the axial and plate width directions.

The purpose of this experiment was to determine plastic region size. It was expected that residual strains are almost null at the boundary between plastic and elastic region, area noted by ????.

Further investigation is to characterize the 3D residual strains profile after removing external load using FEM calculation.

Follow up experiment was rejected in 2014B.



It is expected that residual strains are almost null at the boundary between plastic and elastic region(????).

Request to beam line supervisor is to do inspection alpha prime transformation from austenitic microstructure due to cold-work process, this is originally planned in the experiment. Samples have been prepared.