Microstructure and residual strain distribution in cast duplex stainless steel studied by neutron imaging

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The neutron imaging and diffraction instruments at Materials and Life Science Experimental Facility (MLF) at J-PARC are expected to play an important role in the microstructure characteristic evaluation of steel materials further for industry application. Neutron transmission spectrum measured at a neutron imaging detector coupled with time-of-flight (TOF) method at a pulsed source, can quantitatively and non-destructively visualize the spatial distributions of the wider area by 2D mapping of textures and the microstructures information inside a relatively thicker material than the traditional electron, X-ray and neutron experiments.

In this study, neutron imaging experiment was performed using NOBORU, BL10 of MLF at J-PARC. Four kinds of cast duplex stainless steel with ferrite and austenite microstructure were studied here, which were produced by different casting method at different temperature. Firstly, a two-dimensional scintillation detector using wavelength-shifting (WLS) fibers [1] with pixel size of 0.52mm × 0.52mm and illuminated area 55mm × 55mm was used for data collection. Then, measurement by Micro Pixel Chamber (μPIC)-based neutron imaging detector [2] having higher spatial resolution about 0.2mm was conducted. Data analysis code RITS (Rietveld Imaging of Transmission Spectra) [3] will be used for microstructure including crystalline phase, lattice strain, crystallite size, texture evaluation.

This work was supported by Photon and Quantum Basic Research Coordinated Development Program from the Ministry of Education, Culture, Sports, Science and Technology, Japan.

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