MS39-P04

Enhancement of accuracy of neutron atomic resolution holography

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Needless to say, the properties of the materials strongly depend on arrangements of atoms. In particular, for functional materials, the properties are controlled by doping a small amount of foreign elements, in which slight difference between the local atomic structures around the dopants and average structures of the crystals is important for the properties. However, the diffraction cannot observe such local structures because of lack of translational symmetry. Atomic resolution holography (ARH) is the unique technique that can directly observe the local structures in a three dimensional space within 20 Å from the selected atoms (dopants). On the other hand, ARH reproduces artifacts in principle, so called twin images. Note that such artifacts can be avoided by using data obtained with many different wavelengths [1]. Thus, we are developing ARH using pulsed neutrons at Japan Proton Accelerator Research Complex at Tokai, Japan, which can obtain holograms of 130 different wavelengths at once by the time of flight method [2].

We measured a single crystal of 0.13 at% B doped Si, and succeeded in visualizing the local structure around B; we confirmed that most of doped B are located at the substitutional site. As a next step, to estimate positional accuracy of obtained atomic images of B doped Si quantitively, we measured a single crystal of NaCl as a standard sample. For neutron ARH, prompt γ-rays from the dopants are observed. Thus, as a required condition of good standard samples, the elements in the samples have to generate high intensity prompt γ-rays. Though intensity of γ-rays from Na and Cl is about 500 times smaller than that of B, total No. of Na and Cl atom is 300 times larger than that of the doped B in Si; therefore, ARH of NaCl single crystal is feasible. Besides, NaCl is a good example to confirm whether materials with elements which generate weak prompt γ-rays can be targets of neutron ARH. In our presentation, the results of B doped Si and the estimation of accuracy based on the analysis of NaCl will be reported.

From the recent results, we believe that neutron ARH is a powerful probe for determination of local structures around dopants in various and exotic materials. In particular, investigations of hydrides will be feasible in near future.

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Use of X – ray diffraction method for residual stresses measurements in lean duplex stainless steel welds

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In welding processes, the used of adequate energy is very important, it should be sufficient to prevent sticking but not too large to prevent grain growth, resulting in intense residual stresses and a decrease in mechanical properties of materials [1]. This research investigated effects of weld heat input and thus the cooling rate on mechanical properties in particularly residual stresses evolution.

The studied material was received in the form of 6mm lean duplex stainless steel rolled sheet, LDX 2101(EN 1.4162, UNS S32101). The plates with single-V groove were joined using a TIG process for three different heat inputs.

Microstructures of different zones were observed and captured using optical microscope and scanning electron microscope (SEM) with an EDS analyzer. The ferrite content was assessed in light optical microscope using image analysis software. The X-ray diffraction method which employs Bragg's theory was used to evaluate the residual strains then the residual stresses present within the weld. The extents of longitudinal and transverse residual stresses were carried out on the basis of the $\sin^2\psi$ method, which is very employed for polycrystalline materials [2].

The microstructural analysis revealed different regions with a fusion zone which contains more austenite than the heat affected zone HAZ and parent material [3]. It is observed an increase in amount of austenite in weld metal within heat input increases, this low ferrite content in the weld can be attributed to high Ni content in the filler metal (7.5–9.5 % Ni) and the presence of austenite stabilizer N_2 in shielding gas.

The measurements of RS were made on the {211} atomic plane of the studied material at 2θ= 156.105°, presented compressive stresses in longitudinal and transverse directions reaching a maximum stresses in the weld area. These residual stresses are due to high plastic deformation and temperature gradient involved in weld metal.

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