MEASUREMENTS OF THE STRESS DISTRIBUTION IN THE PERPENDICULAR DIRECTION TO THE SURFACE FOR THE ANODE-SUPPORTED SOFC

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We measured the stress distribution in the perpendicular direction to the sample surface for the anode-supported planar SOFCs by the X-ray diffraction method. In this measurement, we focused on the stress distribution of the electrolyte under the cathode. In order to detect the diffraction from the electrolyte under the cathode, we selected the X-ray energy of 23 keV.

The sin^2ψ method was employed to measure the residual stress. To measure the stress distribution, it is required to control the penetration depth of the X-ray beam in the electrolyte. In order to control the penetration depth, both θ and χ circles were fixed to be appropriate angles simultaneously, satisfying the ψ angle and the penetration depth.

Figure 1 shows the schematic view of the configuration for the measurements. χ and θ are selected so that they would meet the following equation.

\[ \chi = 90 - \arccos \left( \frac{\cos \psi}{\cos \delta} \right) \]

\[ \omega = \theta - \delta \]

\[ \delta = \arccos \left( \frac{d}{L} \right) \]

\[ d: \text{penetration depth}, \ L: \text{optical path}. \]

Figure 2 shows the d-sin^2ψ plot measured using diffraction peak of 8YSZ (711) plane. The slopes of the plots for two cases with different penetration depth are different, and thus the stress distribution in the perpendicular direction to the sample surface was measured using this method.

Microstructural analysis of cementite crystals in drawn pearlitic steel wires

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The X-ray diffraction experiments of drawn pearlitic steel wires were performed with synchrotron radiation in order to reveal effects of the drawing process to the microstructure of cementite crystals.

The patented pearlitic steel wire and the drawn wires with true strains (ε) of from 0.24 to 3.35 were used as specimens. The specimen wires of 10 mm length were thinned mechanically down to 0.2 mm in thickness so that they can transmit the X-ray beam.

The X-ray diffraction profiles were measured with the large Debye-Scherrer camera installed in BL19B2. An imaging plate was used as a detector. The incident X-ray beam had the wavelength of 0.0499 nm and the beam size of 0.3 mm × 3.0 mm. The exposure time was set to be 60 seconds and 600 seconds for obtaining diffraction profiles of ferrite mainly and of cementite mainly, respectively.

Figure 1 shows diffraction profiles obtained from the patented wire (ε=0) and the drawn wires with the true strain of 0.24, 0.86, 1.50 and 3.35. The strong diffraction peaks identified as ferrite (α-Fe) and diffraction peaks identified as cementite were observed in the profiles. The peak intensity of cementite decreased with increasing the true strain. Although few diffraction peaks of cementite were observed in the drawn wire with the true strain of 3.35, some broad peaks were observed at the positions of cementite (12), (021), (200), (120), (113) and (122) diffraction peaks. Furthermore, halo peaks caused by an amorphous structure were not observed in the diffraction profile. Figure 2 shows a relationship between the width of cementite (130) diffraction peak and true strain of the steel wire. The peak width remarkably increased at the true strain larger than 1, and the drawn wires with the true strain larger than 2.5 had four times wider peak width than the patented wire.