Textures Analysis using Neutron All Directions Scattering for Dissimilar Material Junctions

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Weight reduction is an important issue for automobiles and transportation equipment as an energy-saving measure. Among them, joining dissimilar materials such as steel plates, aluminum, and CFRP is indispensable, and it is important to build analysis technology for the joined parts. The analysis of the joint is generally performed by polishing the cross section, observing the structure with an optical microscope, electron microscope, etc., and backscatter diffraction (EBSD). These are still indispensable as analysis techniques for joints. However, there are still many problems such as statistical accuracy, changes in residual stress during cross-section preparation, average information in the depth direction, and difficulty in in-situ observation. Neutron diffraction is a technology that solves these problems. Neutrons have no charge and have excellent permeability, and by using the Time of Flight (TOF), it is possible to supplement neutron scattering data even in places where there is no detector.

The structural parameters obtained by Rietveld analysis of each bank are shown. It was confirmed that the lattice constants of both Fe and Al were increased by spot welding. It was also found that only Fe increases in the atomic displacement parameter (B) and crystallite diameter (Crystallite). Local distortion increases only in Al. It was confirmed that the stress (σ) increases only in the σ11 and σ22 directions of Fe. Figure 1 shows the positive electrode point diagram of the Fe, Al base material, and Fe-Al bonding test piece. Regarding Fe, the base metal has an aggregate structure, but after joining, it shows a powder-like dividing ring and is considered to be in an amorphous state. On the other hand, for Al, the texture is shown even in the joined state. It is necessary to carefully judge whether this structure is in the state before welding or the structure formed at the time of welding, and it is necessary to consider it by making full use of other analyzes and calculations.

Figure 2 shows the reverse pole figure of the Fe, Al base material, and Fe-Al bonding test piece. Regarding Fe, the base metal is strongly oriented in the [111] direction in RD, but not in the [111] direction in the welded test piece, and the orientation in the [101] direction can be confirmed. With respect to Al, the base metal is oriented in the [001] direction for ND, TD, and RD. Orientation in the [111] direction for ND and in the [001] direction for RD is also confirmed. On the other hand, it is considered that the ND after welding is strongly oriented in the [001] direction, the TD is slightly oriented in the [111] direction, and the RD is oriented in the intermediate direction between the [001] and [111] directions.

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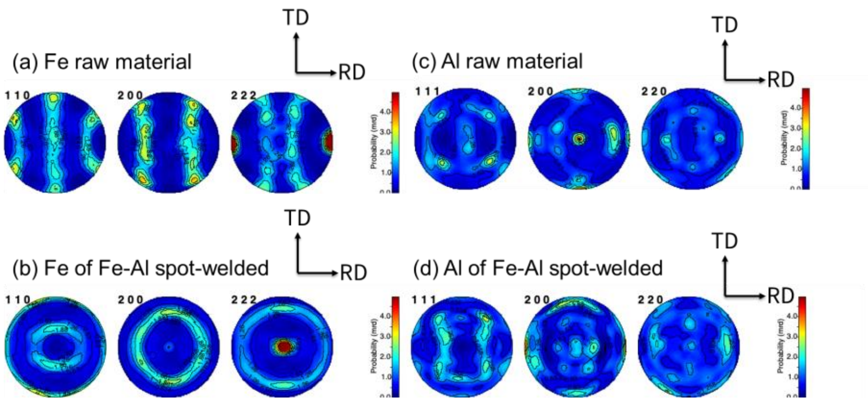

Fig.1 Pole figures of (a), (b): Fe-Al raw material, (c), (d): Fe-Al welded junction with [110], [200], and [222] directions.

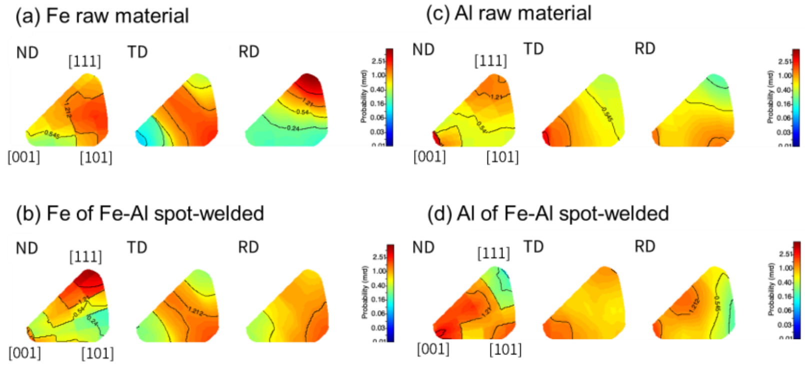

Fig.2 Revers pole figures of (a), (b): Fe-Al raw material, (c), (d): Fe-Al welded junction with ND, TD, and RD directions.