Abstract
Welding area of metal plate specimens welded using ultrasonic welding system is studied. Welding specimens used are aluminum (JISA1050P) and copper (JISC1100P) plates of 0.3 mm thickness. These specimens welded using 19 kHz ultrasonic welding system are inspected using SEM and Energy dispersive X-ray spectroscopy for the purpose of observing the diffusion and the formation of an intermetallic compound of aluminum and copper.

Introduction
Ultrasonic metal welding is useful to join same and different materials with small temperature rise, small deformation and damage of the weldment, and used widely in various fields.

However there have been few studies about the microstructural behavior at the joint boundary, and that is not fully understood from the viewpoint of metallurgical engineering.

This study was carried out to understand first an information microstructural behavior at the joint surface of materials welded by linear ultrasonic vibration welding system.

Ultrasonic welding equipment and specimens
Configuration of an 19 kHz ultrasonic welding equipment
Figure 1 shows the arrangement of the 19 kHz ultrasonic metal welding equipment. The welding equipment consists of a bolt-clamped Langevin type PZT longitudinal transducer, a booster for amplifying vibration velocity, a tool horn with welding tips at the free edge and a welding frame with a static pressure source. The tool horn is driven in axial direction by a 19kHz longitudinal vibration system. The welding tip vibrates in linear vibration locus.

Welding conditions
The upper specimens are 0.3-mm-thick pure aluminum (JISA1050P), and the lower specimens are 0.3-mm-thick pure copper (JISC1100P). Vibration amplitude used is 22 µm (peak-to-zero value), static clamping pressure is 55MPa, and weld time is 0.3sec.

SEM observation
Figure 2 shows the result of SEM observation of aluminum (JISA1050P) and copper (JISC1100P) plates welded using the 19 kHz welding equipment. The boundary of welded specimens appears clearly and provides no evidence of fusion and the formation of an intermetallic compound.

Energy dispersive X-ray spectroscopy
Figures 3 to 5 show the results of dispersive X-ray spectroscopy of the cross sections of the aluminum and copper plate specimens.

From these results, copper atoms and aluminum atoms are diffused mutually at welding surface. Especially the diffusion of copper atoms in the aluminum specimens is observed clearly. The rates of copper atoms in the aluminum and the aluminum atoms in the copper at the point 1µm off from the
Conclusions

(1) The SEM observation of welding boundary provides no evidence of fusion.

(2) The results of energy dispersive X-ray spectra provide no evidence of the intermetallic compound formation of aluminum and copper by the variation of these spectra.

(3) The diffusion of the copper atoms in the aluminum at the points 1 μm off from the welding surface is observed clearly at the rate of 25%.

References
