

Fig. 6 — SEM micrographs of the vicinity of solidification cracks in boron-added AISI 304 welds. A — Crack forms away from ripple line; B — end of crack tip; C — start of crack tip; D — Width of white area becomes smaller closer to the ripple line. Note: Arrows in the micrographs indicate crack tips.

vicinity of the ripple line where its width becomes smaller as shown in D. Such wide, white areas are not observable to the left (*i.e.*, low-temperature side) of the end of the crack. These observations indicate that the wide, white region was formed immediately after crack initiation by low-melting-point eutectics flowing into the high-temperature side of the crack opening and refilling the crack (*i.e.*, healing effect). These white regions of eutectic were therefore investigated in detail.

**Eutectic Formation at Crack Tips**

Figure 7 compares typical SEM micrographs of crack tip areas of three heats

of AISI 304-B steels from Group 1 with high P and S contents. In B and C, the cracks have large widths and white regions indicating the presence of eutectic formations. The white region is particularly wide in the 0.78 wt-% B steel. In the heat without boron (micrograph A), no eutectic is observable at all.

The eutectic area ratio (*i.e.*, the ratio of the area of the white regions to the total area of the field of view) is shown as a function of the boron content in Fig. 8, and it can be seen that the area ratio of eutectic increases linearly with the boron content. Also, compared to the high P and S steels, the eutectic area ratio tends to be greater in the low P and S steels.

**Eutectic Melting Temperature**

The results of measurement of the eutectic melting temperature in the 0.78 wt-% B steel, as observed in a hot-stage microscope, are presented in Fig. 9 for a heating rate of 0.067 K/s (from 1273 K). The three inset photographs show the microstructures in the vicinity of a solidification crack at different temperatures. On heating, eutectic melting commenced at 1451 K and was completed at 1455 K.

The inset micrograph 1 in Fig. 9 shows the microstructure at 1450 K just before melting commenced. Below this temperature, the eutectic and the dendritic

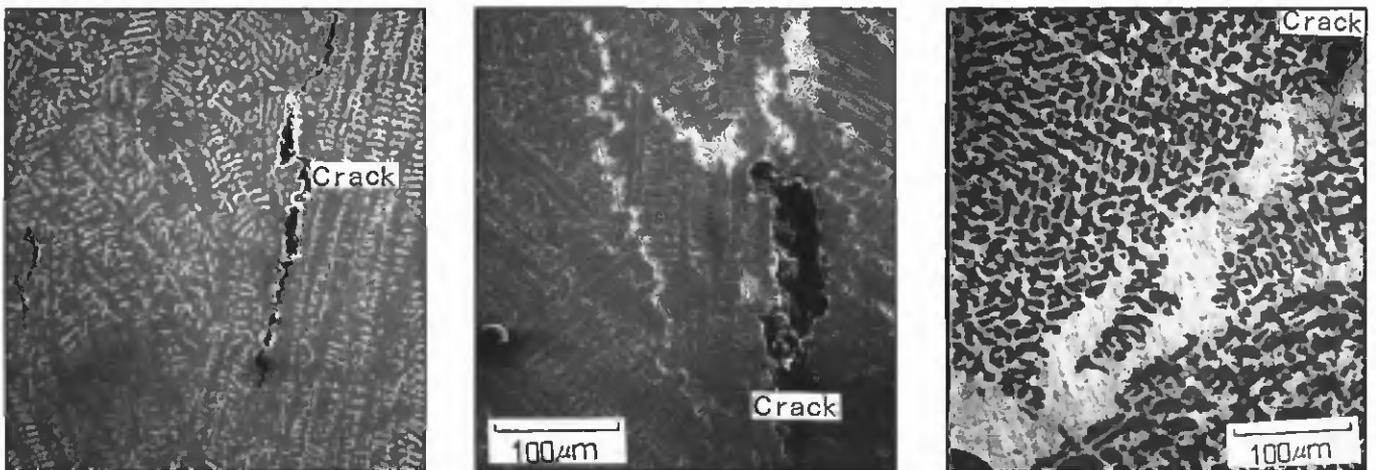


Fig. 7 — SEM micrographs in the vicinity of solidification cracks in boron-added and boron-free AISI 304 welds with high P and S. White regions are eutectic formations. A — 0% B (No. 1); B — 0.20% B (No. 2); C — 0.78% B (No. 4).







