MECHANICAL PROPERTIES AND MICROSTRUCTURE OF F-82H WELDED JOINTS USING CO_2 LASER BEAM --- N. Yamanouchi, K. Shiba [Japan Atomic Energy Research Institute (JAERI)]

OBJECTIVE

On going work is being conducted to characterize the mechanical properties of welded joints of F-82H. The joints were prepared with CO_2 laser beam to make a small specimens for the irradiation experiments.

SUMMARY

The laser welding of F-82H was successfully conducted. The heat affected zone of the welding was about 2 mm width. It was quite adequate to make small specimens, such as SS-3 type sheet tensile specimen.

INTRODUCTION

As the reduced-activation material for the first wall of fusion reactor, we have developed a 0.1C-8Cr-2W-0.2V-0.04Ta steel (referred to as F-82H hereafter) [1,2].

EXPERIMENTAL DETAILS

The ingot of F-82H was made from high purity commercial raw materials using with a vacuum induction furnace. The ingot was heated at 1523 K and rolled into a slab. The slab was rolled to 15 mm thickness plate. The plate was heat-treated as follows: normalized for 1.8 ks at 1313 K followed by tempering for 3.6 ks at 1013 K. The chemical composition of the steel are given in Table 1. The thin plates (2 mm thickness) of F-82H were machined from 15 mm thickness plate which was a factory product. The thin plate cut into 50 mm length along the rolling direction and 300 mm width.

Two plates were contacted each other without gap to make a 100 mm length and 300 mm width plate. The plates were welded by 3 kW CO_2 gas laser beam radiation moving along the seam line at 33 mm/s in Ar gas shield of which flow rate was 3.3×10^{-5} m^3/s.

After welding, stress relieving heat treatment on the weldment was conducted at 993 K for 3.6 ks. This temperature was 20 K lower than the tempering temperature of the base metal. The Vickers hardness of the cross section of the weld joint was measured with 50 g load for the as weld and the stress relieving heat treated specimens. The measured positions are shown in Fig. 1.

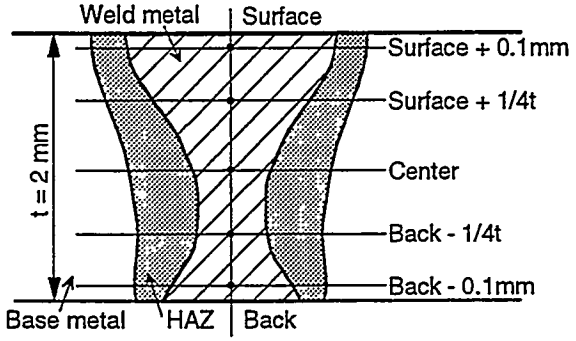

Fig. 1 The locations of the hardness measurement of the laser weld joint

Table 1 Chemical composition of F-82H

Elements (mass%)								
C	Si	Mn	P	S	Cu	Ni	Cr	Mo
0.097	0.09	0.07	0.002	0.003	-	0.030	7.46	<0.001
V	Nb	B	N	Al	Co	Ti	Ta	W
0.18	0.00007	0.0004	0.004	0.014	0.005	0.01	0.030	2.1

RESULTS

The view of the seam and the cross section of the weld joint are shown in Fig. 2 and Fig. 3, respectively. The hardness of the weld joint are plotted on Fig. 4. The maximum hardness of the weld joint were improved from Hv 473 to Hv 315 by the stress relieving heat treatment. The size of the heat affected zone was about 2 mm width. Small tensile specimens (SS-3 type sheet tensile specimen; gauge section: 7.62^{L} x 1.52^{W} x 0.76^{t} mm) were machined from the weld joint. Fig. 5 shows the cross section of the tensile specimen indicating the location of the welding.

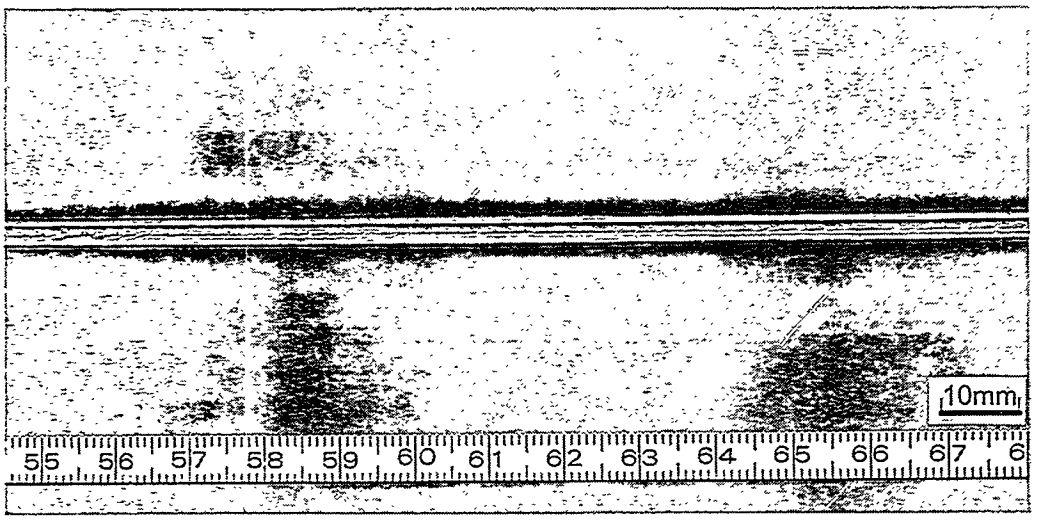

Fig. 2 The view of the seam of the weld joint

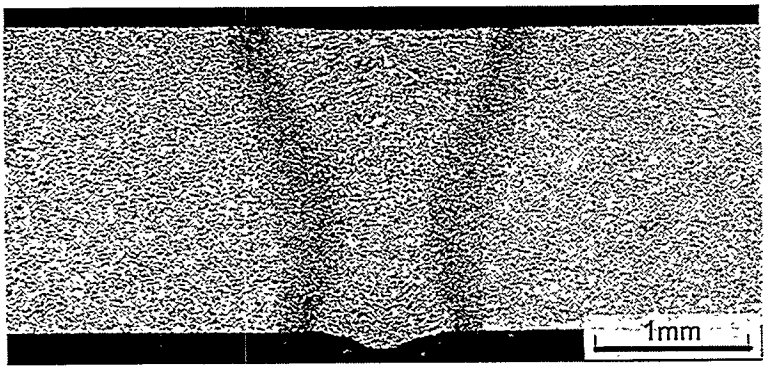

Fig. 3 The view of the cross section of the weld joint

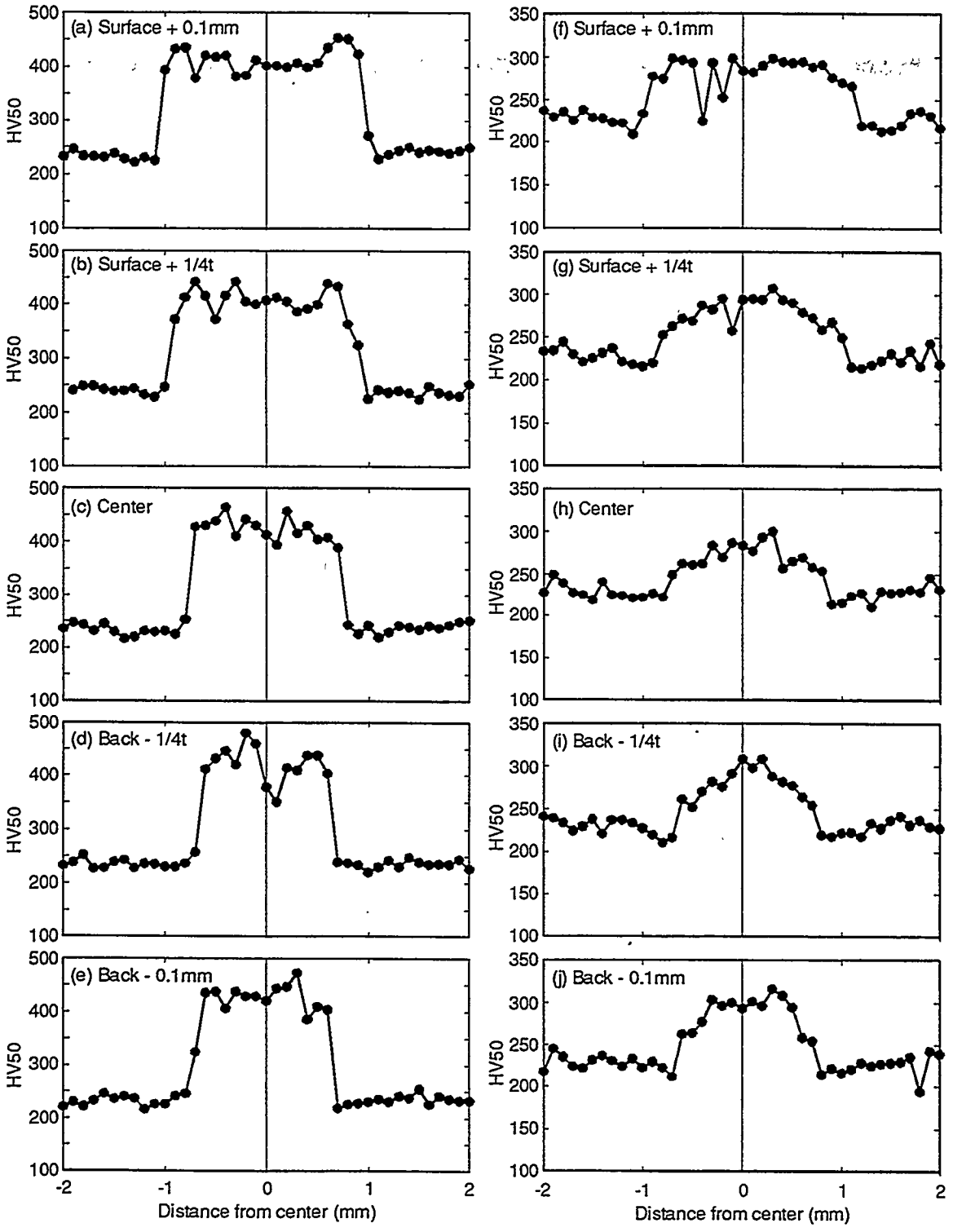

Fig. 4 Vickers hardness of the laser welded joints; (a) - (e): as weld, (f) - (j): stress relieving heat treated

CONCLUSIONS

The laser welding of F-82H was successfully conducted. The heat affected zone of welding was about 2 mm width. It was quite adequate to make small specimens.

FUTURE WORK

The measurement of the tensile properties of the weld joint using the small specimens are in progress. Ductility of the weld joints must be measured to compare with that of after irradiation using small specimens. These results will be compared with the TIG welded joints irradiated in the same conditions.

REFERENCE

[1] M. Tamura, H. Hayakawa, M. Tanimura, A. Hishinuma and T. Kondo, J. Nucl. Mater. 141-143 (1986) 1067.

[2] M. Tamura, H. Hayakawa, A. Yoshitake, A. Hishinuma and T. Kondo, J. Nucl. Mater. 155-157 (1988) 620.

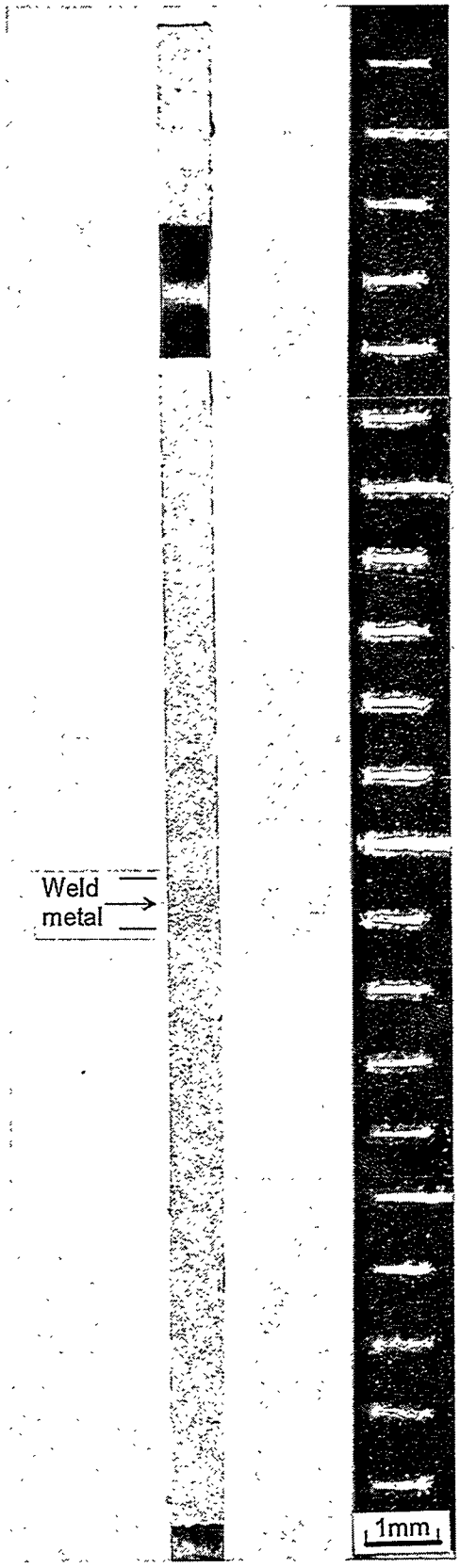

Fig.5 Cross section of the SS-3 specimen