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Comparison of Welding Characteristics on Heat input Changing of Laser Dissimilar Metals Welding

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ABSTRACT

Laser welding of dissimilar metals has been widely used to improve a wear resistance and a corrosion resistance of the industrial parts. The objective of this research works is to investigate the influence of the process parameters, such as the welding for SM45C and STS304 with CW Nd:YAG lasers. The bead-on-plate welding tests are carried out for several combinations of the experimental conditions. In order to quantitatively examine the characteristics of the dissimilar welding, the welding quality of the cut section, stain-stress behavior and the hardness of the welded part are investigated. From the results of the investigation, it has been shown that the optimal welding condition without defects in the vicinity of the welded area and with a good welding quality is 1600W of the laser power, 0.85m/min of welding speed and 4 ℓ in of pressure for shielding gas.

Key Words : Laser welding(), Butt welding(), Welding speed(), Aspect ratio(), STS304(), SM45C(), (Heat input capacity)

1. (3)

가

Mai⁽⁴⁾ 350W Nd:YAG

가 1mm

kovar

Brüggemann⁽⁵⁾ RSt37-2 (Al-Mg-Si0.7)

(1) 5kW CO

(6)

STS304 SM45C 500~600W

가 0.5mm

(2)

Wave: CW) Nd:YAG 가 3mm

STS304 SM45C

가

STS304 SM45C

(aspect ratio)가 , 가 ,
(Heat Affected Zone:HAZ)가 가

가 가 가 가
가 가 가 가

(phase)

가 가

SM45C
STS304

가

(bead on plate)

Nd:YAG (1.06 μ m)
STS304 SM45C

(7)

SM45C STS304 가

SM45C STS304

2.

2.1

Nd:YAG 1.06
 μ m 2.8kW
2kW (continuous wave : CW)
600 μ m

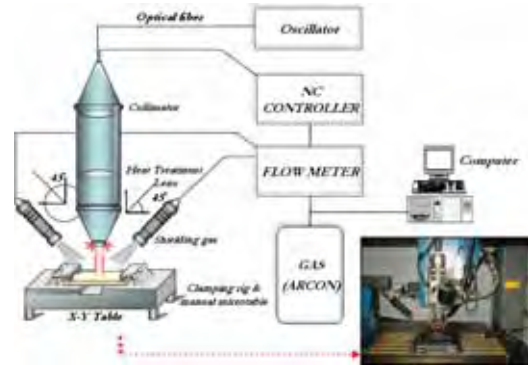


Fig. 1 Schematic diagram of the experimental set-up

25mrad , 가
LASMA 1054 ,

Fig 1

가 Rotary 가
LASMA 1054 , x, y,
z 1000 \times 500 \times 400mm . x , y
5 μ m, z 1
 μ m, 8 μ m .

2.2

STS304 SM45C
100mm(L) \times 50mm(W) \times 3mm(T) .

Table. 1, Table. 2 . STS304 SM45C
Nd:YAG 가 가
(Ar)

가 3~4 /min .

1600W
2000W f=200mm D
가 60mm
z=0
1.0m/min ~ 10m/min

(BUEHLER : isomet 4000

precision Saw 1) (sand paper)
(CuSO 10mg + Hcl 50M ℓ + H O 50M ℓ)
(Nikon:ECLIPSE L150)

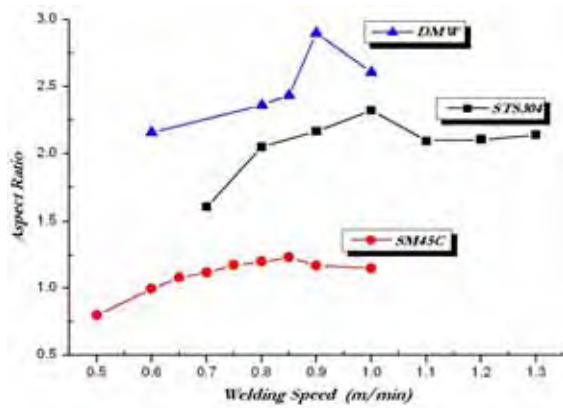


Fig. 3 Influence of Welding speed on the Aspect Ratio

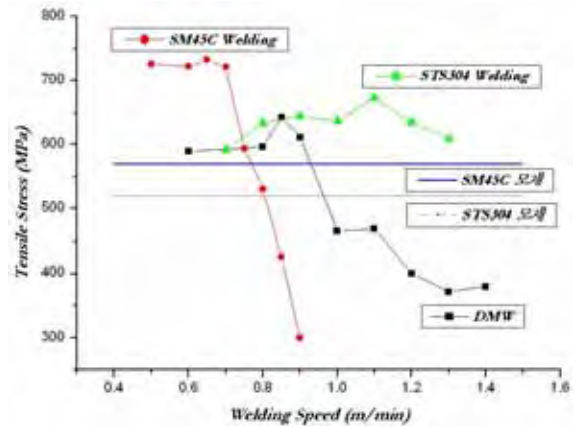


Fig. 4 Strain-Stress relationship for various dissimilar welding condition

$$E = \frac{P}{W \cdot v} \text{ J/cm}^2 \quad (1)$$

Fig 3 (2) A-R H W
 STS304 SM45C
 STS304 가 SM45C 가
 SM45C STS304
 가
 가 STS304 가
 가 SM45C 0.85m/min 가
 가 1.0m/min 가

$$A \cdot R = \frac{H}{W} \quad (2)$$

Fig 2 STS304 SM45C
 가
 가 SM45C 0.85m/min,
 STS304 1.0m/min 0.9m/min 가
 Fig 2 Ni, Cr,
 C가

3.2

가

SM45C STS304
 (KS)
 (Instron Corporation U.S.A
 Universal Testing Machine 4206. 15ton)
 Fig 4
 Fig 4
 STS304
 SM45C
 SM45C 가 0.7m/min
 가
 가
 STS304
 가
 STS304
 SM45C
 가 0.9m/min SM45C STS304
 Fig 4
 가 0.6m/min, 0.7m/min, 0.8m/min,
 0.9m/min Fig
 3
 가 0.9m/min
 C
 가
 Ni 가
 Cr 가
 C 가
 SM45C
 가 0.4m/min 0.7m/min

가
 가 SM45C STS304
 Ni
 0.9m/min 가

3.3

Fig 4
 DMW
 Fig5 (a) STS304 (b)
 DMW (c) SM45C
 STS304 SM45C
 SM45C
 가
 hole) 가 (Key
 SM45C STS304
 STS304 Ni Cr

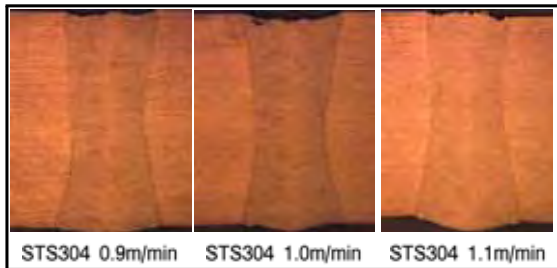


Fig. 5(a) Influence of Welding on the bead shape(STS304)

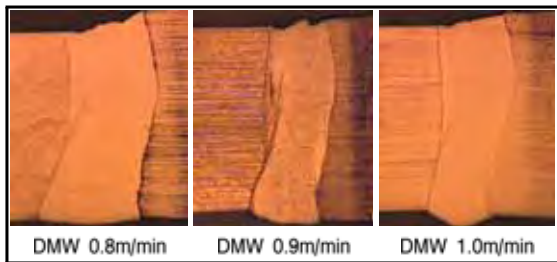


Fig. 5(b) Influence of Welding on the bead shape(SM45C)

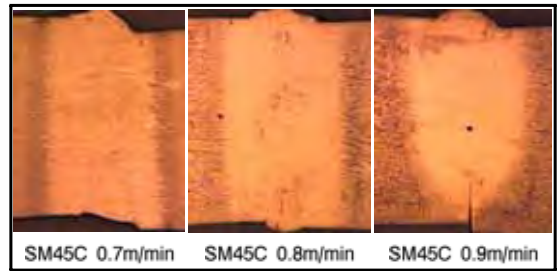


Fig. 5(c) Influence of Welding on the bead shape(DMW)

SM45C C
 STS304
 SM45C DMW (b) STS304
 가 SM45C
 STS304
 Ni DMW
 가 0.6m/min, 0.7m/min, 0.8m/min, 0.9m/min
 가
 Fig 4 STS304
 Mn S FeS
 MnS S
 MnS 가 1620 Mn
 가

3.4

SM45C STS304
 Fig 8 Fig 8 SM45C Fig
 STS304
 4 가
 SM45C
 가
 0.7m/min 가 3
 가
 가
 Fig 4 STS304
 가 가 1.0m/min
 1.1m/min 가
 STS304 SM45C DMW
 Fig 9 Fig 9
 0 SM45C,
 STS304 Fig 8
 3mm
 DMW 2mm

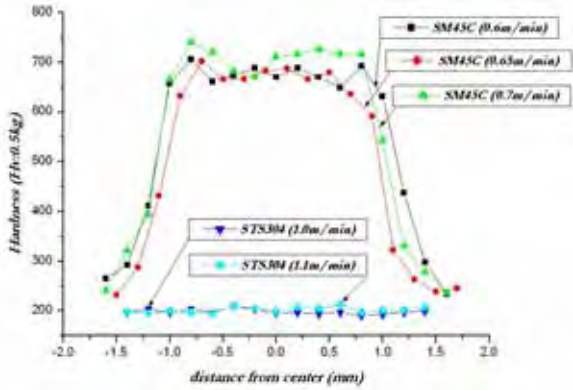


Fig 8 Develop to Hardness on the welding distance

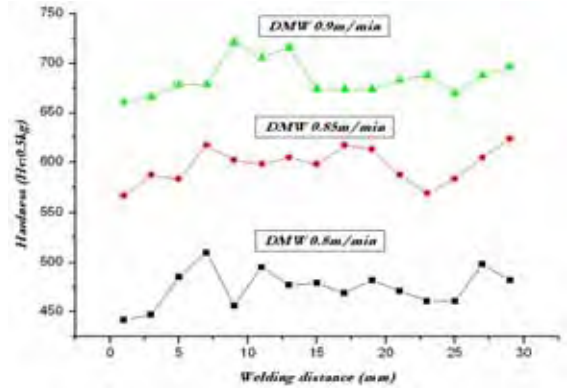


Fig 10 Develop to Hardness on the welding distance (Vertical)

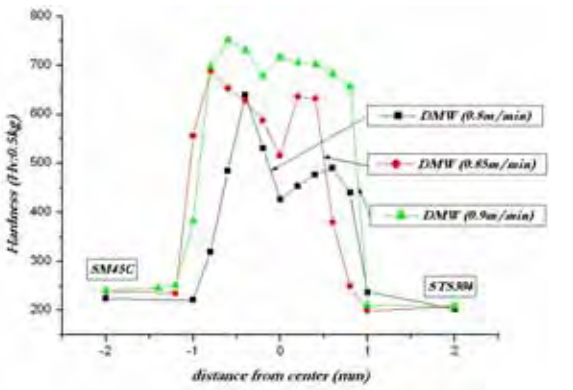


Fig 9 Develop to Hardness on the welding distance (Horizontal)

Cr Ni C
 Cr(7.188), Ni(8.845)
 (1.5~2.1)가
 Fig 9
 STS304 SM45C가
 SM45C STS304
 Fig 8
 DMW
 DMW 가
 가 STS304 가
 가 Ni 1455 , Cr 1890
 가 가 3550 C
 가 Cr
 Cr

Fig 10 DMW

5~6mm 가
 가

4.

SM45C
 CW Nd:YAG
 304
 1. 가 가 (Heat input)
 가 가 (Aspect Ratio)
 2. SM45C STS304
 SM45C STS304 가
 3. Ni, Cr, C
 5~6mm 가
 4. SM45C 0.7m/min,
 STS304 1.1m/min DMW 0.9m/min

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