（TC4）

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(1. 　　　　　　　　　　　 300072; 2. 　　　　　　　　　　　　　　　300072;

3. 　　　　　　　　　18　　　　　300381)

　　　　：　　　　　　　　　　9 mm　TC4　　　　　　　　　　　　　　；　　　　　　　ABAQUS　　　　　　　．

　　　　　　　　　　　　　　；

　　　．

　　　：　　　；　　　；　　　　；　　　；

0

　　　　　　　　　　　　　`、　　　`、

`、

　　　　　．

　　　　　　　　　[1]．　　　　　`、

　　．

　　[2]．　　3　6 mm　　　　TC11

　　　　　　　　　　　；

[4]　ANSYS　　　12 mm　　TC4

　　　　　　．

　　　　　．

　　　9 mm　　　TC4

ABAQUS

　　　　　．

　　　　　．

1

　　　　　　9 mm　　TC4

　　`、　　　　　　1.

120 mm × 100 mm × 9 mm.

TECHMETA　　　　　　　．

　　＋　　　　　　`、　　　　．

　　　　　　　　　1 m/min

`、　　　　　．

　　　　　2.　　I

1　　．　　9 mm　　TC4

3.

表 1　TC4　　　（　　　%）
Table 1　Chemical compositions of TC4

Al	V	Fe	Si	C	N	H	O	Ti
6. 06	3. 92	0. 3	0. 15	0. 01	0. 05	0. 0015	0. 2	

表 2　TC4
Table 2　EBW process experiments of TC4

	U/kV	I_{f}/mA	I_{b}/mA
A	40	50	2 050
B	40	80	2 050
C	40	120	2 050
D	60	80	2 550
E	60	60	2 550
F	60	50	2 550
G	60	40	2 550
H	60	30	2 550
I	60	36	2 550

正面

反面

3 4 5 6 7

3 4 5 6 7

图 1 Ⅰ

Fig. 1　Weld profile of group I

表 3

Table 3　Optimum process parameters of EBW

I_f/mA	U/kV	I_b/mA	v/(m·min^{-1})
2 550	60	36 ~ 40	1

2

2.1

$$\rho c = \frac{\partial}{\partial x}\left(\lambda\,\frac{\partial T}{\partial x}\right) + \frac{\partial}{\partial y}\left(\lambda\,\frac{\partial T}{\partial y}\right) + \frac{\partial}{\partial z}\left(\lambda\,\frac{\partial T}{\partial z}\right) + \overline{Q} \quad (1)$$

:ρ　c　λ　　　　　、

;$\overline{Q}$　　　　　　1.

2.2

6

2　:

z　　　　　　　　　z

;

$$q_1(r\,z) = \frac{9f_1\Phi}{\pi h r_0^2}e\left(-\frac{3h^2}{(h+z)^2 r_0^2}(x^2+y^2)\right) \quad (2)$$

$$q_2(r\,z) = \frac{6\sqrt{3}f_2\Phi}{abc\pi^{\frac{3}{2}}}e^{-3\left(-\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}\right)} \quad (3)$$

:Φ　　　　　　　　　;f_1　f_2

;r_0　　　　　　　　;r　　　　　　　;h

;a　b　c　　　　　　.

(a) 圆锥热源　　　　　(b) 双椭圆热源

图 2
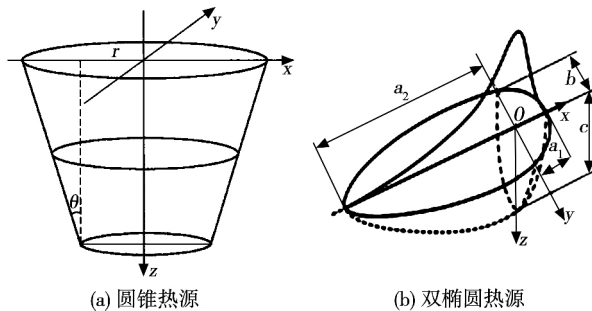
Fig. 2　Schematic diagram of heat source

2.3

(100 mm × 60 mm ×
9 mm)　　　.

0.5 mm

0.5 mm × 0.5 mm.

DC3D8　　　　　C3D8R.

TC4　　　　0 ~ 500 ℃

5

x　y　　　　　　.

2.4

2.4.1　温度场计算结果分析

6.25 s　　　　　　3 000 s.

Fortran

33 ℃

0　0.6　1.825　2.875 mm

3　　　;

4　　;　　　　　　5　.

3　:

3 750 ℃　.
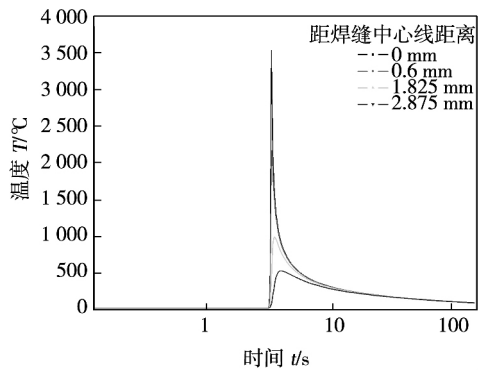
图 3

Fig. 3　Thermal cycling curve
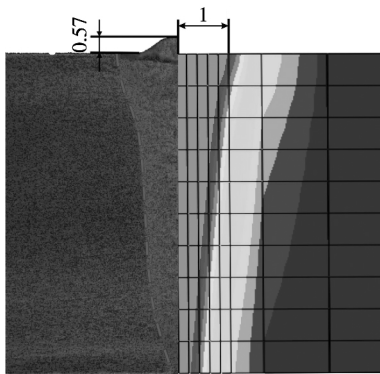
图 4　　　　　　　　　　　（mm）

Fig. 4　Contrast of calculated pool and weld profile
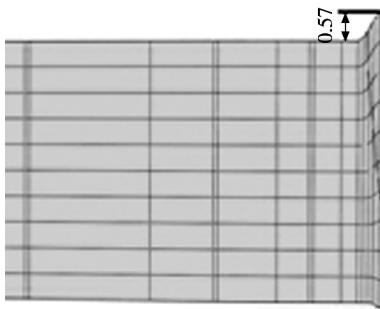
图 5　　　　　　　　　（mm）

Fig. 5　Calculated weld reinforcement

．　　　　　　　　0.6 mm

2 400 ℃　　　　　　　　3 mm　　　　　　　　500 ℃

．　　　　　　　　　　　　　　2 250

℃/mm．

．　　　　　　　　　　　　　　．

4　5　　　：

．　　　　　　　　　1.9 ~ 2.1 mm

2.0 mm　　　　　　；

0.55 ~ 0.58 mm　　　　　　　0.57 mm

．

2.4.2　应力场计算结果分析

图 6　．

（　　　　　1.5 mm　　　　　　1.6 mm）

TC4　　　　　　　（图 7）

图 8　图 9　；　　　　（图 2）

图 10　；

（图 3）　　　　　图 11．

图 6

Fig. 6　Equivalent residual stress distribution

图 7
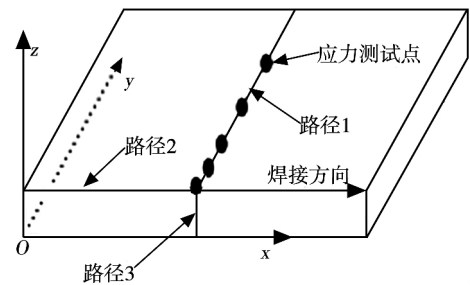
Fig. 7　Test points and simulation results path

图 8
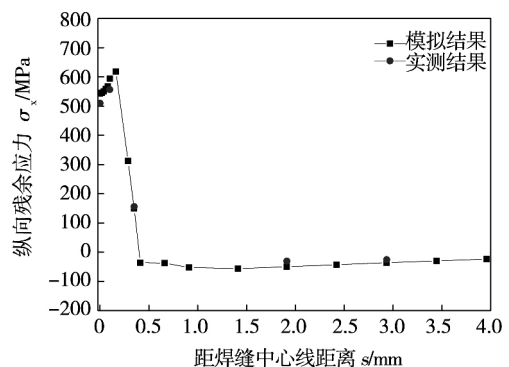
Fig. 8　Longitudinal stress on vertical weld line

图 6　　　：　　　　　　　　2 mm

820 MPa　　　　TC4

（920 MPa）．

3.5 mm　　　　　　　140 MPa

．

4 mm　　　　．

9
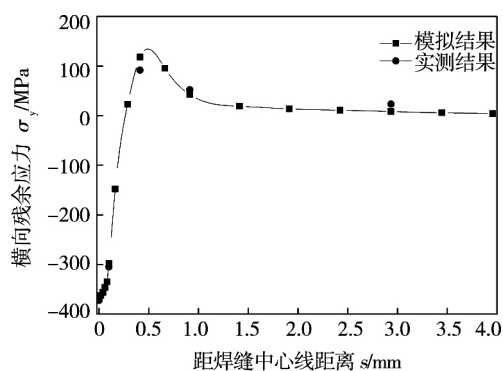
Fig. 9   Transverse stress on vertical weld line

10
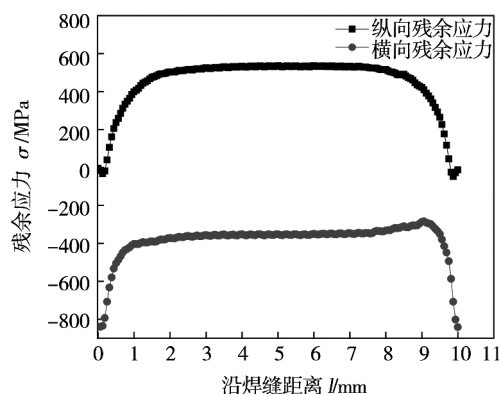
Fig. 10   Stresses of weld center

11
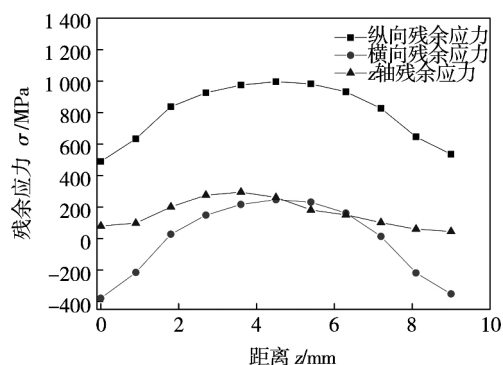
Fig. 11   Stress in thickness of weld center
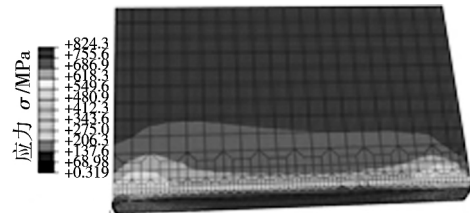
8   9   :

.

600 MPa;

.   10

600 MPa.

;

− 350 MPa.

.

11   :   (3)

;

.

;

.

3

(1)   9 mm   TC4

.

(2)

.

(3)

.

:

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Abstract:　In order to understand the corrosion resistance of different materials surfaces machined by micro wire electrical discharge machining（MWEDM）　the specimens of three kinds of materials　including W18Cr4V　60Si2Mn and M42　were separately processed. The micro electrolytic cell equipment and electrochemical workstation were applied to test the corrosion resistance of specimen surfaces　and the electrochemical impedance spectroscopy and potentiodynamic polarization curves were measured and analyzed. Besides　the surfaces after corrosion were observed with inverted metallurgic microscope　and were compared to flat grinding surfaces. The results showed that corrosion resistance of MWEDM surfaces was superior to that of flat grinding surfaces. For different materials　corrosion resistance of MWEDM surfaces was significantly different from each other. For the same material　the surface with better corrosion resistance could be obtained by using appropriate processing parameters.

Key words:　micro wire electrical discharge machining; corrosion resistance; electrochemical impedance spectroscopy; potentiodynamic polarization curve

Using dynamic induction heating to inhibit martensite structure formed in heat-affected zone of U71Mn steel rail after surface welding　YAN Wentao　LI Xiaoyan　LI Hui　SUN Jiantong（School of Material Science and Engineering　Beijing University of Technology　Beijing 100124　China）. pp 97 – 100　108

Abstract:　A dynamic induction heating method was used to inhibit the formation of martensite in heat-affected zone （HAZ）of U71Mn steel rail after surface welding. The inhibition of martensite structure was characterized by optical microstructure analysis and microhardness testing. The experimental results showed that when the U71Mn steel rail was welded in cold welding condition　cracks would form directly in the heat-affected zone　and the microstructure was martensite. With the increase of preheating and post-heating temperature　the amount of martensite reduced significantly. When the preheating temperature was 320 ℃ and post-heating temperature was 550 ℃　the martensite structure could be inhibited completely　and the heat-affected zone consisted of sorbite structure whose size was smaller than pearlite structure in the base metal. The microhardness of the heat-affected zone also distributed uniformly.

Key words:　dynamic induction heating; U71Mn steel rail; surface welding; martensite

Arc pressure analysis in variable polarity TIG welding　CHENG Lin　HU Shengsun　WANG Zhijiang（Tianjin Key Laboratory of Advanced Joining Technology　Tianjin University　Tianjin 300072　China）. pp 101 – 104

Abstract:　The arc pressure during horizontal variable polarity gas tungsten arc welding （VPTIG）was measured by pressure transducer under different welding conditions. The radial distribution of arc pressure was investigated　and the central arc pressures for DC TIG welding and VPTIG welding with a period of 5% and 15% for direct current electrode positive （DCEP）were compared. The experimental results showed that the radial distribution of VPTIG pressure was hyperbolic. When the welding current was in the range of 100 A to 140 A and with the same root mean square value　the arc pressure decreased gradually with the increase of time ratio of DCEP at one cycle during DC TIG welding and VPTIG welding with a period of 5% and of 15% for DCEP　due to the difficulties of electron emission and arc divergence in the period of DCEP. And the integrated arc force was directly proportional to the square of welding current.

Key words:　hyperbolic distribution; arc pressure; horizontal welding; variable polarity gas tungsten arc welding

Effect of hot-cutting defect on reliability of brazing process in ceramic package manufacturing——II. Brazing structure design　ZENG Chao　WANG Chunqing　TIAN Yanhong　ZHANG Wei（State Key Lab of Advanced Welding and Joining　Harbin Institute of Technology　Harbin 150001　China）. pp 105 – 108

Abstract:　Reliability of brazing process in ceramic package manufacturing depends on the interaction between thermal stress induced by mismatch of CTE （coefficient of thermal expansion）and defect in ceramic generated in the process before brazing. This paper based on the feature that defects with different degrees of danger spatially locate differently　and employed ANSYS software to analyze the distribution of the thermal stress in brazing process. A novel idea of avoiding the stress locating at defect region was applied to improve the reliability of assembly process. This idea is different from the traditional optimizing method to lowering the stress over the whole component　and is more flexible for the package design　and it is also more effective for improving the reliability of ceramic package manufacturing.

Key words:　thermal mismatch; package structure; process reliability

Finite element numerical simulation of electron beam welding of TC4 titanium alloy　ZENG Qingji[1]　XU Lianyong[1,2]　HAN Yongdian[1,2]　JING Hongyang[1,2]　ZHOU Chunliang[3]（1. School of Materials Science and Engineering　Tianjin University　Tianjin 300072　China; 2. Tianjin Key Laboratory of Advanced Joining Technology　Tianjin 300072　China; 3. The 18th Research Institute of CETC　Tianjin 300381　China）. pp 109 – 112

Abstract:　The optimized welding parameters for electron beam welding of 9 mm thick TC4 titanium alloy plate were obtained. A finite element model was established based on ABAQUS software　and the simulated results of the weld appearance and residual stress on the weld surface agreed well with the experimental results. This proved that the combined heat source with highly penetrating cone heat source and highly irradiative dual-ellipsoid heat source could characterize the electron beam welding. Further simulated results showed that high residual stress occurred around the weld　especially　dangerous three-dimensional tensile stress existed within the weldment.

Key words:　electron beam welding; TC4 titanium; finite element numerical simulation; residual stress; composite heat source