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MAIN TOPICS, ABSTRACTS & KEY WORDS

A Real-time Infrared Measurement System of Welding Temperature Field with the Dual-wavelength Type Optical Filter   JIANG Li-pei (Beijing Institute of Petrol-chemical Technology, Beijing 102600, China), ZHANG Jia-ying, LI Hong-hui. p1 ~ 4

Abstract: A new infrared temperature measure system based on the calorimetric method has been developed to survey the welding temperature field in real-time. There is a special dual-wave length optical filter set in the system, which makes it possible that infrared images with two different wavelengths can be synchronously sampled through one camera lens. The filter was built by joining of two half-round filters, which are designed to have different wavlengths. The values of the dual-wavelength are designed according to the requirement of the calorimetric method and are 0. 805 $\oplus$0 $\oplus\mu$m and 0. 895 $\oplus$0 $\oplus\mu$m in this paper. By animing the joint line of the filter at the center of the welding pool, the dual-wavelength infrared images of the welding temperature field can be caught with a single lens CCD camera, i. e. the two half rounds of the image are different on the wave-length. Since the joint line of the filter is very narrow, the bilateral symmetrical points' gray scales of the images can be treated as dual-wavelength data of the same point. In this way, the each pint's temperature of the welding field near the pool can be calculated with the calorimetric method. Based on it, the welding temperature including the fusion region can be further derived. The advantage of the system is that the infrared temperature measurement device has been simplified for practical application of measuring the welding temperature field.

Key words: welding temperature field; dual-wavelength optical filter; infrared temperature measurement

Identification Models of Weld Pool Dynamic Process in Pulsed GTAW   CHEN Shan-ben(Shanghai Jiaotong Univ., Shanghai 200030, China), CHEN Wen-jie, LIN Tao. p5 ~ 8

Abstract: The dynamic process of the weld pool is a high complex object with strong non-linearity, mult-variable coupling and a mount of stochastic and uncertain factors. It is very difficult to obtain an analysis mathematic model of weld pool dynamics. Thus the modeling of weld pool dynamics becomes a puzzle problem for weld technique engineers and control system designers, which also is an essence handicap in weld automation. In order to realize the effective control of the pulsed GTAW pool process, this paper investigated the dynamic characters of the pulsed GTAW from the classic control systems, and obtained two SISO transfer function models by the system identification method, one model for input pulsed time of welding current via output back weld width, the another

for input weld travel speed via the output back weld width. The established models in this paper would be useful to study the controlled performance of weld pool dynamic process in the pulsed GTAW and can be used as has a valuable references and direction for designing its control system.

Key words : pulsed GTAW; weld pool dynamic process; identification model

Effect of Fillet Geometry on Shear Stress Distribution in Al-Al$_2$O$_3$ Soldering Assembly   MA Xin (National Key Laboratory of Welding, Harbin Institute of Technology, Harbin 150001, China), FENG Ji-cai, DONG Zhan-gui, LIANG Xu-wen. p9 ~ 11

Abstract: In the welding construction made of different materials, the cooling stage after welding will cause thermal stress due to the mismatch of coefficient of thermal expansion between different materials. Meanwhile, the fillet geometry has played an important role on this thermal stress distribution. In this work, by means of finite element numerical simulation, the effect of fillet geometry on the shear stress distribution in the Al— Al2O 3 soldering assembly had been analyzed. The calculating results showed that the optimized geometry of soldering fillet is a concave shape in which the extruding length of the soldering fillet is a little more than the gap height.

Key words: finite element numerical simulation; Al— Al$_2$O$_3$ soldering; shear stress; fillet geometry

Statistical Analyzing Evaluation Method of Dynamic Characteristic of CO$_2$ Arc Welding Power Source   ZHANG Xiao-nan(Tianjin University, Tianjin 300072, China), LI Jun-yue, HUANG Shi-sheng, YANG Yun-qiang, LI Huan. p12 ~ 16

Abstract: For the CO$_2$ welding of dip transfer, the electrical signals of the welding process are not only random, but also the carrier of abundant information of various physical phenomena of arc. For the random signal using the statistical analyzing method is easy to transfer the signal into the compact and accessible format, which can reflect the situation of the whole welding process. Mean while the characteristic information interrelated with the welding result can be extracted out and showed as exact figures and tables, basing on which it is hopeful to objectively evaluate the dynamic characteristic of CO$_2$ arc welding power source. Therefore, in this paper, the principle of the statistical analyzing method of arc welding is discussed. The experimental research of the dynamic characteristic of CO$_2$ arc welding power source is carried out. On these bases, an adopting statistical analysis extraction method of the characteristic infor-

mation for the evaluating dynamic characteristic is studied. The statistical characteristic information and vector for the evaluating dynamic characteristic are extracted at last. The studying results show that when the dynamic characteristic is changing, the markedness of the characteristic information in the statistical characteristic vector also changes according to a definite rule. This result establishes a base for the statistical analyzing evaluation method which can be used to evaluate the dynamic characteristic of the arc welding power source according to the change of the statistical characteristic information. s

Mechanism of Longitudinal Intermittent Alternative Magnetic Field on Weld Formation in Tungsten Inert-gas Arc Welding

LUO Jian (Shanghai Jiaotong University, Shanghai 200030, China), JIA Chang-shen, WANG Ya-sheng, XUE Jin, . p17 ~ 20

Abstract: The cause and rule of weld formation of mild steel, stainless steel and LD10CS aluminum alloy are studied in GTAW (tungsten inert-gas arc) welding with a longitudinal intermittent alternative magnetic field by measuring the parameter and taking the weld arc photograph. Under the research conditions described in this paper, the actions of GTAW welding arc property, fluid flow in pool and solidification process are changed due to the applied longitudinal intermittent alternative magnetic field, which produced by the single excitation coil above or under the pool, so the weld formation changes. When the excitation coil and arc center are non-coaxial, the effect of applied magnetic field on weld formation is stronger, especially for the ferromagnetism metal.

TIG Welding of High Manganese Austenitic Steel for Super Cryogenic Application

FU Rui-dong (Yanshan University, Qinhuangdao 066004, China), LI Liang-yu, ZHENG Yang-zeng. p21 ~ 24

Abstract: In this paper, investigated the microstructure and cryogenic properties of TIG welding joints for $32Mn-7Cr-0.6Mo-0.3N$ austenitic steel by means of some methods such as metalography, scanning electron micro-scope, X-ray diffractometer, hardness test, cryogenic tensile test and so on. The test results showed that the satisfied welded joints can be achieved using TIG welding of Argon and Nitrogen mixed protection. The joint microstructure is fine and homogeneous, and some welding defects such as crack and blowholes are not found. The 77 tensile fracture surfaces exhibit a tough character mainly composed of dimples. The decreasing of Nitrogen content in wended joints can be effectively suppressed by adding little Nitrogen into shielding gas, and better cryogenic strength of joint can be gained. The 77 tensile strength of smooth is about 1⨂150⨂MPa. The reasonable mixture rate of Nitrogen in shielded gas is 4%. The joint microstructure has high stability, and keep fully austenite phases in welds and HAZ after welding.

Diffusion Bonding of Si₃N₄ Ceramic to Ni with Non-active Metal Interlayers of FeNi/Cu

CHEN Zheng(East China Shipbuilding Institute, Zhenjiang 212003, China), GU Xiao-bo, FANG Fang, LI Guo-an. p25 ~ 28

Abstract: Diffusion bonding of Si_3N_4 to Ni was carried out using non-active metal interlayers of FeNi/Cu under high and low vacuum conditions. After bonding, HIP processes were also used for some joints. Joint strength was determined by four-point bending tests. The joint interfaes were analyzed by mines of SEM, EPMA and XRD. The results shown that high joint strength could be obtained even under low vacuum bonding condition. The reaction layer of Ni-Si system compound was not formed at the interface between ceramic and the metal. Bonding time did not have visible effect on the joint strength. These characters are quite different from those when active metal is employed as interlayer in diffusion bonding. The method suggested in this paper has important foreground for engineering applications.

Knowledge Acquiring in Intelligent Detecting System for Lack of Weld

WANG Bing(Shanghai Jiaotong Univ., Shanghai 200030, China), LIN Tao, CHEN Shan-ben. p29 ~ 32

Abstract: It is the most important to acquire knowledge in intelligent systems and it reflects the intelligence level of the system. To apply soft computingtools to acquire knowledge is a focus of researchers from all over the world. As a new soft computingtool, the rough set theory has enormous potential in applying and it has been widely applied in lots of fields such as pattern recognition, medical diagnosis, medical data analysis, image processing, quality control, fault diagnosis, data mining, process control and so on. In our detecting system, traditional methods could not satisfy requirements for the restricition of real conditions and factors of operators and intelligent methods must be adopted. In order to realize the intelligent detecting, how to dffectively acquire knowledge is the key problem. to apply the rough set theory to acquire a correlative elementary knowledge and then optimize the knowledge by neural networks can improve the efficiency of acquiring knowledge. The method of acquiring the correlative elementary knowledge with rough set theory in our intelligent detecting system is given in this paper.

Grain Distribution Properties of Superalloy GH4169 Inertia Friction Welded Joint

YANG Jun(Shanghai Jiaotong University, Shanghai 200030, China), LOU Song-nian, YAN Jun-min, SHI Wei-qing. p33 ~ 35

Abstract: The Vickers hardness, microstructures and properties of GH4169 are very sensitive to heat-processing techniques. Coarsening and mixed grains will appear when mistechniques are choosen. It increases the stress rupture sensitivity and decreases the impact-toughness. It was found that superalloy GH4169 inertia friction pipe joint has superfine grain and fine grain distributing along the axial direction by the research experiment conditions. This phenomenon was analyzed according to the dynamic recrystallization property of superalloy GH4169 and the unique thermo-deformation condition in inertia friction process. The result shows that the temperature, strain and strain rates of superalloy GH4169 are the main reasons to cause the fine and superfine grain microstructure. Hot deformation dynamic recrystallization process is very rough and sufficient in the weld region of GH4169 inertia friction pipe joint, and the microstructure shows fine and homogenous equiaxed grains. There is no coarsening and mixed grains been found, although the grains are not

homogenous in the whole joint.

Key words: superalloy; inertia friction welding; dynamic recrystallization

Difficult Problems and Its Countermeasures of Brazed Bonded Monolayer Diamond Grinding Wheel   WU Zhi-bin(Nanjing University of Aeronautics & Astronautics, Nanjing 210016, China), XU Hong-jun, YAO Zheng-jun, XIAO Bing. p36~38

Abstract: Monolayer diamond grinding wheel Manufactured by brazing diamond grit to steel substrate of grinding wheel with active brazing filler mental has distinct advantages over traditional electroplated monolayer diamond grinding wheel. The paper pointed out the existing technical difficult problems, which are how to increase bond strength, how to improve the uniform of the brazing layer thickness and how to realize regular distribution of diamond grit. Some countermeasures to solve them are discussed. Firstly, Ni—Cr or Ag—Cu—Cr alloy was used as an active filler mental for brazing diamond grit, which can provide high bond strength through Cr_7C_3 and $Cr_{23}C_7$ produced by interaction between Cr atom of Ni—Cr or Ag—Cu—Cr alloy and C stom of diamond surface at elevated temperature. Secondly, regular grits were distributed in accordance with optimized topography. On the analyses, a diamond grit wheel with high bond strength, regular grit distribution and uniform layer thickness of the brazed alloy was developed.

Key words: grinding wheel; brazing; monolayer; diamond grit

Numerical Analysis of Diffusion Hydrogen Distrbution in Welding Zone for HQ130 High Strength Steel   LI Ya-jiang(Shandong University, Jinan 250061, China), SHEN Xiao-qin, SUN Bin. p39~43

Abstract: The distribution of diffusion hydrogen in welding zone of HQ130 high strength steel is calculated by using finite element method (FEM). And their effects on weld crack are analyzed. The finite element program of hydrogen diffusion in welding zone is worked out. In the program, the effects of weld heat input (E), temperature, plasticity distortion, surface escaping coefficient of hydrogen etc. on hydrogen diffusion are taken into account. The numerical analysis indicated that hydrogen accumulates seriously near the fusion zone, especially in weld root. This is an important factor to cause crack in this zone. Increasing weld heat input and surface escaping coefficient of hydrogen can decrease hydrogen accumulation in the fusion zone of weld surface, but it is not obviously sin weld root. Increasing dislocation makes hydrogen accumulate seriously in fusion zone. The results of test and analysis indicate that the heat input in the middle weld should be controlled to about 16 kJ/cm to prevent crack generating and propagating for HQ130 steel.

Key words: high strength steel; welding; fusion zone; diffusion hydrogen

Computer Simulation of Residual Stress Field of Hardfacing Metal and Effect of Specimen Dimension   YANG Qing-xiang(Yanshan University, Qinhuangdao 066004, China), LI Yan-li, ZHAO Yan-hui, YAO Mei. p44~46

Abstract: The distribution of the temperature and stress fields during hardfacing have been measured and simulated with steel 60CrMnMo by means of a X-ray diffraction analyzer and a software of ANSYS in this paper. The measured results show that there are two peaks of residual tension stress in the center and heat-affected zone of hardfacing metal. Meanwhile, the calculated result of residual stress was compared with the measured one, which prove that the Finite Element method is effective. By using this method, the influence of different dimensions of this specimen on residual stress distribution was simulated. The calculated results show that with the increasing of the specimen dimension, the peak values of residual stress are increased and theirs positions are changed as well.

Key words: temperature field; stress field; residual stress; finite element analysis

The Composition and Microstructure Character of Bond Area of Supereutectic ZA Alloy in TIG Welding   LIU Xiu-zhong(Shandong University, Jinan 250061, China), ZHAO Dong-jian, ZHANG Jong-fa, ZHU Xing-hai. p47~50

Abstract: The influence of the evaporation and oxygenation of zinc during welding process was studied. The character of microstructure and micro-rigidity of bond area of the ZA alloy in the TIG welding was investigated using TME、SME and other methods. The results show that when filler material is similar to parent mental, Zn content in bond area is lower than that in the weld and the parent metal. The Cu and Al contents in bond area are higher than that in the parent metal. The microstructure morphology of the bond area is mainly columnar dendrite. The microstructure in room temperature is mainly Zn phase、α phase and compounds of Al_4Cu_9, $CuTi_2$, $Al_7Cu_3Mg_6$. The microstructure in bond area has bigger change and is tiny near the weld. Some fine and thin lamella Zn and α-Zn similar to pearlyte can be observed ther. The microstructure near the parent metal is coarser, but it is still thinner than that in the the parent metal. The coarse grained zone did not appear as the case in alloy steels. The thin compounds of the bond area have higher micro-hardness. They can strengthen the basic structure. When welding super-eutectic ZA alloy by TIG welding method, there is no coarse overheated microstructure happened. But thin microstructure and compound can strengthen base. This is advantageous to improve the mechanical properties of the welded joint.

Key words: ZA-alloy; TIG; bond area; structure character

One-knob Intelligent Control System of CO_2 Welding Machine   YU Jian-rong (Beijing Institute of Petrochemical Technology, Beijing 102600, China), JIANG Li-pei, SUN Zhen-guo, WANG Jun-bo. p51~54

Abstract: A microcomputer intelligent control system has been developed for self-optimizing of the arc voltage in CO_2 welding process. The system can automatically adjust the arc voltage in accordance with the set welding current value. The major models in the system are the arc voltage fuzzy control model, the welding current control model and the one-knob recommending table. The arc voltage fuzzy control model takes the synthetic evaluation value of characteristic parameters in the welding process (the short-circuiting transfer frequency f_d, the ratio of arc duration to short-circuiting duration t_{as}, and the short-circuiting period standard deviation σ) as a basis to optimize the arc voltage value. The testing results show that the developed self-optimizing control system obviously improve the performance of CO_2 welding machine and reduce welding spatter.

Key words: CO_2 welding; one-knob; intelligent control

Through-the-Wire Sensor of Short-circuit CO_2 Welding   BAO Yun-jie(Tsinghua University, Beijing 100084, China), ZHU Zhi-ming, WU

Wen-kai. p55~58

Abstract: Through-the-wire sensor of the waveform-controlled short-circuit CO_2 welding is studied in this paper. A system designed for wire extension signal measure and process is established based on the MCU (Motorola MC68HC11A1) after theoretical analysis of wire extension heat transfer and its resistance, molten drop profile and its resistance properties. During the period of short-circuit, the wire extension is approximate the distance from the welding torch to work piece, so that it can be used as the sensor for determining the height of welding torch, and for realizing the seam tracking. The processing results show that the short-circuit voltage between the torch and work piece is in direct proportion to the wire extension, when welding current keeps constant during the medium-term of short circuit. The actual measure accuracy of the sthrough-the-wire sensor can reach ±0.4mm, therefore the requirements of torch height control and wire energy compensation control of CO_2 welding can be met perfectly.

Key words: through-the-wire sensor; short-circuit transfer; torch height; waveform controlled CO_2 welding

Expert System of Weld Crack Diagnosis Based on Knowledge Base

ZHU Yuan-xiang(Wuhan University, Wuhan 430072, China), ZHANG Xiao-fei, SUN Qin-ming, LI Xiao-mei. p59~62

Abstract: An expert system of welding crack diagnosis based on knowledge base is posed according to the analysis of characteristic of weld crack. The General structure of system and object-oriented model are discussed in the paper. A data base (DB) is set up according to system demand, a case base (CB) founded through accumulating cases, rule base (KB) established after accepting expert experience and knowledge of this field, and a model base (MB) built according to the structure of knowledge. The four bases are recombined in the expert system. The diagnostic methods based on case, rule and model were described. Compared with each other, the advantage and disadvantage of these reasoning methods are obtained. The mixed reasoning based on case, rule and model is posed to overcome their shortcoming, retain fully their advantage and find the answer to the problem as possible. The definition, representation and calculation of the degree of similarity and rule representation are discussed. The function of system and way of realization are described in the paper. It is proved by application that the expert system of weld crack diagnosis based on knowledge base can achieve the same diagnostic result as the expert.

Key words: welding; crack diagnosis; expert system; knowledge base; welding crack

Welding between Fe-Cr-2Al-Si Damping Alloy and 1Cr18Ni9Ti Stainless Steel

ZHANG Zhi-An(Sichuan University, Chendu 610065, Chian), GAO Sheng-ji, XU Yong-gang, Wang WEI-guo, ZHENG Si-kui. p63~66

Abstract: The welding technology and quality of Fe-Cr-2Al-Si damping alloy and 1Cr18Ni9Ti steel have been investigated, with Tungsten Insert Gas Welding (TIG), and a high-alloy austenitic stainless welding wire. The microstructure of welded joints was investigated by means of metalloscope. The major results obtained are as follows: an excellent weld structure with austenite, a little ferrite and martensite was obtained, the tensile strength and bend performance in the welded joint zone were higher than that in the damping alloy. The applied welding method, filler materials and weld process can satisfied the welding

requirements of these two kind of materials. In addition, the quality of weld is reliable.

Key words: Fe-Cr-2Al-Si damping alloy; 1Cr18Ni9Ti stainless steel; weldability

Study of Fatigue Crack Propagation Rate for 20MnHR Steel Used in Nuclear Industry

JIA Fa-yong(Tianjin University, Tianjin 300072, China), HUO Li-xing, ZHANG Yu-feng, YANG Xin-qi. p67~70

Abstract: The fatigue crack propagation rate test has been carried out for the HAZ and weld of 20MnHR steel used in nuclear industry. Compact tension (CT) specimens were used in the test. The number of valid HAZ and weld specimens is respectively 14. In test, $(da/dN)_1$ and $(\Delta K)_1$ of each group specimens were computed with seven point incremental polynomial technique. All $(da/dN)_1$ and $(\Delta K)_1$ data of 14 HAZ specimens and 14 weld specimens were respectively together to carry on regression analysis. As a result, found the inflective point of crack propagation rate, and brought forward respectively relation of $(da/dN)_1$ and $(\Delta K)_1$ by means of the Paris crack propagation formulas based on plane strain behavior and plane stress behavior. The test results and analyses showed that the Paris formulas based on plane strain behavior can be applied to practical welded structures with considerable confidence.

Key words: fatigue crack propagation rate; HAZ; weld

Study of Measuing Technology about Impact Toughness of Welded Joint with High Strain Rate

Yu Qin(The Northwest Institute of Nuclear Technology, Xi'an 710024, China), Gong Shui-li. p71~75

Abstract: To meet the needs of studying impact toughness of welded joint, established a measuring system of impact toughness with high strain rate by combining the Hopkinson device of gas gun loading model with the measuring technique of three-point bending specimens in gas gun device of split Hopkinson pressure bar. Some technical problems such as loading, recording, data treatment, dynamic effect and so on have been solved. Impact tests of joint welded with E5015 electrode were carried out using common V-type notch specimen and precast crack V-type notch specimen. Ideal results showed that the design thinking of the system is right, and test data is reliable.

Key words: welded joint; impact toughness; measuring technique; high strain rate

Investigation on Safety of Watering Pipe

JIA Da-gong(Tianjin University, Tianjin 300072, Chian), ZHANG Yu-feng, HUO Li-xing, YANG Xin-qi. p76~78

Abstract: Welded pressure pipes were widely used in the fields of energy source, transportation and so on. It is very important to ensure the safety and reliability of pressure pipes, that in the hydroelectric power station is the focus, because once it is destroyed, the heavy loss zoill be suffered. Based on the experiments the fracture characteristics of welding joint in new pressure pipes used for hydroelectric power station were discussed at room temperature in this paper. The ANSYS codes have been employed to simulate the conditions of pipe loading and to analyze the piping stress distributions. According to ASME Piping Flaw Evaluation, the stability and safety in ferritic steel piping have been calculated. The assessment results indicated that the safety could meet the requirement of working conditions.

Key words: pressure pipe; fracture toughness; finite element; safety assessment

The Effects of Laser Shock Processing on Mechanical Properties of Welded Jionts(I)   ZOU Shi-kun (Beijing Aeronautical Manufactory Technology Research Institute, Beijing 100024, China), WANG Jian, WANG Hua-ming. p79 ~ 81

Abstract: When a short pulse, high peak power ($> 10^{13} \text{W/m}^2$) laser irradiated to a metel surface, an impulsive wave, which is generated by a high-pressure and high-temperature plasma confined by the transparent medium, propagates into the material interior, thereby inducing strain hardening. We call this surface strengthening technology as "laser shock processing" or "laser shock peening". The laser shock processing (LSP) can improve the surface hardness, tensile strength and gain a compressive stress layer or hardened layer with thickness much lager than that in the case of conventional peening, which is more benefit for the improvement of fatigue properties. In order to study the application of laser shock processing as a post weld treatment technology, the welded beads of a Ni-base super alloy GH30 sheet with thickness of 1.66mm and a austenitic stainless 1Cr18Ni9Ti with thickness 1.2mm were shocked by pulse laser, then the surface residue stress, microhardness, ultimate tensile strength and the fatigue life were compared with those without LSP in this paper. The results show that the ultimate tensile strength of GH30 argon arc welded joints was increased by 12% and the fatigue life of 1Cr18Ni9Ti plasma welded joints was increased more than 300% after shocking.

Key words: laser shock processing; laser peening; welded joints; tensile strength; fatigue life

Improvement of Duty Cycle of Plasma Arc Cutting Machine   TIAN Song-ya (Hehai university, ChangZhou 213002, China), CHENG Li-hua. p82 ~ 84

Abstract: Air plasma cutting machine requires high open-circuit voltage, but arc voltage is half or one-third of it. So far the duty cycle for the high power SCR arc plasma cutting machine is low, which results from bigger angle of lap, and power factor goes down. To ensure rated power output, more input current is required and the coil is heated heavily. In this paper, the topology is changed and the capacitor bank is connected with primary coil in series. The idle work is also compensated to improve load power factor. Therefore, it can reduce input current of transformer primary coil, power factor and duty cycle are raised.

Key words: plasma arc cutting machine; power factor compensating; duty cycle; topology

The Effect of Mechanical Vibration Welding on the Microstructure of Weld and HAZ   ZHANG Guo-fu (Fushun Petroleum Institute, Fushun 113001, China), SONG Tian-min, YIN Cheng-jiang, GUAN Jian-jun. p85 ~ 87

Abstract: The article mainly discussed the microstructure's state of weld and HAZ by mechanical vibration(frequency of vibration is among 33166Hz)welding process. The 16MnR steel commonly used in vessel was used in the experiment. It was welded by SAW while it was being vibrated mechanically in low frequency. Three samples weres separately welded in various frequency and amplitude of vibration. The results show that the mechanical vibration welding can largely improve the microstructure of weld and HAZ, the size of grain of weld was obviously refined, the weld line and over-heated zone were narrowed, and the dimension of widmanstatten structure in HAZ was greatly decreased. Meanwhile, the forming process of weld and HAZ in the current situation was discussed in detail from the point of view of weld pool solidifying process and temperature field. It was also included that the frequency of vibration had not effective effect on the microstructure of weld and HAZ in narrow scope. The mechanical vibration welding had larger effect on the microstructure of weld and HAZ.

Key words: mechanical vibration welding; weld and HAZ; microstructure

The Review on the Keyhole Dynamics of the Electron Beam Deep Penetration Welding Process   ZHOU Qi(Key Laboratory for High Energy Density Beam Processing Technology, Beijing 100024, China), LIU Fang-jun. p88 ~ 92

Abstract: The R &D activities concerning electron beam welding (EBW) keyhole dynamics and, EBW mechanism were reviewed briefly in this paper. The character of the depth and formation of the EBW seam was induced in the three typical stages of EB deep penetration processing. The three stages include the beginning stage, the welding stage, and the fade-out stage. Some special dynamic characteristics were disclosed using some special phenomena in the EBW processing, and at the same time, the physical models of the EB deep penetration were put forward. The different function and application of the inner signal which the EB made acting on the metal target and the characteristic and applicational foreground of the outer signal in the dynamic study of EBW were analyzed. The inner signals include the secondary emitted particles, X-ray, the visible light, the infrared rays, the special sound and etc., and the outer signals are X-ray, the infrared rays, the ultrasonic wave and etc.. The relationship between the two kinds of signals and the experimental methods of the EBW keyhole dynamics was analyzed. Moreover, the research trend on EBW mechanism and keyhole dynamics was prospected.

Key words: electron beam welding; keyhole; dynamics

The Development of Models about Welding Heat Sources' Calculation   MO Chun-li(Institute of Metal Research , The Chinese Academy of Sciences, Shenyang 110015, China), QIAN Bai-nian, GUO Xu-ming, YU Shao-fei. p93 ~ 96

Abstract: This paper summarizes progress in the development of models for calculating the flow of heat in welding. First, an analytic model which is most usually used as centralized point or line and face heat source was put forward. Then a mathematical model for weld heat source based on Gaussian distribution of power density in space was presented. Other models based on Gaussion distribution function were hemispherical power density distribution, ellipsoidal power density distribution, double ellipsoidal power density distribution. The computed temperature distribution in different models was compared and an opinion was made to select different model under different condition. It was shown that the analytic model was more simple and practical, it can be used in many projects. But it had some error near the pool for not considering the effect of penetration arc. The model of double ellipsoidal power density distribution can deal with both the shallow penetration arc welding processes and the deeper penetration laser and electron beam processes and make the calculated value more accurate.

Key words: HAZ; double ellipsoidal power density distribution; thermal cycle