MAIN TOPICS, ABSTRACTS & KEY WORDS

Microstructure and properties of Ni based alloy composite coating by laser cladding-ion sulfurizing process HAN Bin, ZHANG Mengke, CUI Gang, WANG Yong (College of Mechanical and Electronic Engineering, China University of Petroleum (Huadong), Qingdao 266580, China). pp 1-4, 96

Abstract: The composite layer was produced on 45 steel substrate by laser cladding and low temperature ion sulfurizing process. The microstructure and phase composition of laser cladding layer and sulfurizing layer were studied by the means of SEM, EMPA and XRD. The wear resistance and corrosion resistance of the layer by laser cladding and laser cladding and sulfurizing were also studied. The results showed that phase composition of Ni-based alloy laser cladding coating mainly includes γ-(Fe, Ni), $Fe_{0.64}Ni_{0.36}$, $M_{23}C_6$, WC, M_7C_3 and Fe_2B and so on, and its microstructure hardness is up to 740 $HV_{0.2}$. Sulfide layer was produced on the Ni-based alloy coating with low temperature ion sulfurizing process, which is loose and porous, is piled up by the sharp island micro nan-scale particles. Compared with Ni-based alloy laser cladding layer, the friction coefficient and the wear loss of the modified composite layer decrease significantly, excellent antifriction and wear resistance can be obtained. After low temperature ion sulfurizing treatment, the corrosion potential decreases, and the corrosion current density increases and the corrosion resistance of Ni-based alloy laser cladding layer decreases slightly.

Key words: laser cladding; ion sulfurizing; sulfide; wear resistance; corrosion resistance

Numerical analysis of humping formation in high speed GMAW process WU Dongsheng[1,2,3], HUA Xueming[1,2], YE Dingjian[1,2], ZHANG Jing[1,2] (1. Shanghai Key Laboratory of Material Laser Processing and Modification, Shanghai Jiaotong University, Shanghai 200240, China; 2. Collaborative Innovation Center for Advanced Ship and Deep-Sea Exploration, Shanghai 200240, China; 3. Shanghai Power Equipment Research Institute, Shanghai 200240, China). pp 5-8

Abstract: The convection difference between normal speed and high speed GMAW processes was investigated using the numerical simulation, a high speed photography system was used to capture the transient images of the weld pool, and the humping formation in high speed GMAW process was also discussed. The results show that at the longitudinal sectional view of the weld pool behind the arc, both counterclockwise circulation and outward fluid flow pattern exist in normal speed GMAW process, only counterclockwise circulation exists in high speed GMAW process. Two main factors are responsible for the humping formation, one is that the high momentum of the backward fluid flow causes the initiation and growth of swelling, and the other is that the unbalance of normal surface tension force in the welding direction promotes the shrinkage of liquid channel. Any measures that help reduce the surface tension can inhibit the formation of humping.

Key words: GMAW; high speed welding; humping; weld pool convection

Effect of external transverse magnetic field on weld appearance WANG Lin, GAO Jinqiang, YANG Fengzhao (Key Laboratory for Liquid-Solid Structural Evolution & Processing of Materials, Ministry of Education, Shandong University, Jinan 250061, China). pp 9-12

Abstract: In high speed gas metal arc welding (GMAW) process, severe geometric defects such as humping bead and undercutting will occur if the welding speed exceeds the critical value. The previous experiments had shown that the backward flowing molten jet with high momentum in the weld pool is responsible for the formation of humping bead. In this study, an external tranverse magnetic field generator is developed so that the welding current in the weld pool interacts with the magnetic field to produce an additional EMF pointing toward the front part of weld pool. And the EMF can control the backward flowing molten jet in the weld pool and adjust fluid flow field to suppress the occurrence of the humping bead. Bead-on plate welding experiments were performed and the influences of the exerted magnetic flux density on the weld bead formation, the arc and the fluid flow behavior inside the weld pool were investigated. The mechanism of the suppressing humping bead by the external electromagnetic field was revealed. The results show that the external magnetic field can remarkably adjust the fluid flow field in weld pool and prevent the occurance of the weld defects such as humping bead and undercutting, so the quality of weld bead is remarkably improved, and the critical welding speed is notably increased.

Key words: high speed GMAW; external magnetic field; humping bead; backward flowing metal; vision-based observation

Effect of different underwater environment media on composition and temperature of underwater welding arc plasma GUO Wei[1], GUO Ning[1,2], DU YongPeng[2], WANG Fu[1], FENG Jicai[1,2] (1. Shandong Provincial Key Laboratory of Special Welding Technology, Harbin Institute of Technology at Weihai, Weihai 264200, China; 2. State Key Laboratory of Advanced

Welding and Joining, Harbin Institute of Technology, Harbin 150001, China). pp 13-16

Abstract: By collecting and analyzing the underwater welding arc spectrum, the influence of the different water environment media such as clear water, boric acid solution, LiOH solution, and boric acid + LiOH mixture, on the composition and temperature of underwater welding arc plasma were studied. In addition, the composition and temperature of arc plasma during on-land welding and underwater welding were compared and analyzed. The results indicated that the effects of water media on underwater welding arc plasma are almost negligible. However, the H and O in arc plasma composition of underwater welding are significantly more than those in the on-land welding arc. Owing to the water environment, the arc temperature of underwater welding was lower than that of on-land welding arc.

Key words: underwater welding; arc spectrum; arc plasma

Effect of laser remelting on erosion resistance of plasma sprayed Al_2O_3-40% TiO_2 coating YANG Ke, LI Zhenyu, JIANG Yongfeng, BAO Yefeng (College of Mechanical and Electrical Engineering, Hohai University, Changzhou 213022, China). pp 17-20

Abstract: The Al_2O_3-40% TiO_2 coating was made by plasma spraying, and remelted laser beam. The erosion resistance of plasma sprayed coating and laser remelted coating were tested respectively, and the effect of laser remelting on erosion resistance of plasma sprayed Al_2O_3-40% TiO_2 coating was studied. The results show that the layered structure of plasma sprayed Al_2O_3-40% TiO_2 coating can be changed by the laser remelting. The γ-Al_2O_3 phase transforms into α-Al_2O_3, and the laser remelted coating exhibits a stable structure which consists of α-Al_2O_3 and $TiAl_2O_5$. A compact, uniform, highly hard and good metallurgical bonded Al_2O_3-40% TiO_2 coating can be obtained. The erosion resistance of the plasma sprayed coating has been greatly improved by laser remelting, and the wear characteristics caused by the erosion sand particles are crack, crush and block desquamation.

Key words: laser remelting; plasma spraying; coating; erosion resistance

Experimental analysis of weld formation in tandem twin-wire co-pool welding process GAO Yanfeng, HUANG Zhibing (National Defense Key Disciplines Laboratory of Light Alloy Processing Science and Technology, Nanchang Hangkong University, Nanchang 330063, China). pp 21-24

Abstract: A new rotating arc leading tandem twin-wire co-pool welding method was developed in this paper. The developed method has the seam tracking capability of rotating arc weld. The influence of weld parameters such as welding current, arc voltage, two wire distance and arc rotating on welding formation quality were studied. The results show that with the increase of welding current, the deposition rates increases linearly, while the aspect ratio of weld increases firstly and then decreases in the later. With the increase of arc voltage, the aspect ratio of weld decreases slightly. Based on the study of the distance between two wires, it is found that the weld seam quality is better when the distance is 15mm. Compared with the traditional tandem twin-wire welding, in the rotating arc leading tandem twin-wire welding process, the molten pool bottom becomes flat, and the maximum weld depth decreases, but the average weld depth increases, which is helpful for decreasing the stress concentration on the weld seam. Compared with the single wire rotating arc welding, the deposition rate increases apparently, and the welding undercut phenomenon can be avoided during rotating arc leading tandem twin-wire welding process.

Key words: rotating arc; twin-wire welding; Co-pool; weld process

Analysis on failure behavior of micro copper pillar bump for high density flip chip packaging under thermal cycle REN Ning[1,2], TIAN Ye[1], WU Fengshun[2], SHANG Shuanjun[1] (1. School of Mechanic & Electrical Engineering, Henan University of Technology, Zhengzhou 450001, China; 2. Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, Wuhan 430074, China). pp 25-28

Abstract: Based on the Saint Venant's principle, the finite element model of flip chip packaging was established by combing the global model and sub model. The stress and strain of the micro copper pillar bumps were analyzed to study the failure mechanism of the micro copper pillar bumps by high density flip chip packaging and to analyze the crack growth behavior of the key micro copper pillar bump. The results show that the micro copper pillar bump with the maximum distance from the center of the chip has the biggest deformation and the highest stress, which is the key micro copper pillar bump of the flip chip packaging. The accumulative plastic strain energy density are mainly distributed on the substrate side of the key micro copper pillar bump, and the maximum accumulative plastic strain energy density is outside of the micro copper pillar bump, and gradually decreases towards the inside, which shows that the crack initiation appears on the outside of the micro copper pillar bump at substrate side, and expands from the outside to the inside of the solder throughout the whole micro copper pillar bump, eventually lead to the failure. The results are consistent with the simulation results.

Key words: flip chip packaging; micro copper pillar bumps; accumulative plastic strain energy density; failure behavior

Effects of shielding gas flow on microstructure of PAW welded joints of pure Nickel N6 WANG Xijing, ZHAO Qingshan, CHAI Tingxi, JING Wenxia (State Key Laboratory of Advanced Processing and Recycling of Non-ferrous Metals, Lanzhou University of Technology, Lanzhou 730050, China). pp 29-32

Abstract: The effect of shielding gas flow (SGF) on weld microstructure was investigated in the plasma arc welding (PAW) of pure N6 Ni without filler wire. The results show that weld appearance has an obvious metallic luster and no surface defects with the increase of the SGF. The HAZ width on the back side of weld seam increases with the SGF rate being increased, and reaches gradually up to that on the front of weld seam. The grains size increase from the base metal to the center of weld. The grain size in HAZ has no few variations with the increase of the SGF, while the grains in the weld center become gradually coarser. Meanwhile, a large number of pores appear when the shielding gas is not enough. From analysis of SEM and EDS results, there are a large number of oxides with Ni, C, N, and Mg as main components in the inner wall of the porosities in weld, and oxygen-riched impurities groups have a texture of cerebral cortex like.

Key words: PAW; microstructure; shielding gas plow

Neural network compensation for micro-gap weld detection by magneto-optical imaging CHEN Yuquan, GAO Xiangdong (School of Electromechanical Engineering, Guangdong University of Technology, Guangzhou 510006, China). pp 33-36

Abstract: A BP neural network was proposed to compensate detection accuracy of micro-gap weld seam (seam width less than 0.1 mm). The butt welding of low carbon steel was carried out with laser welding. The magnetized weldments were detected by using a magneto-optical sensor and the magneto-optical images of weld seam were captured. By using BP neural network and processing weld seam magneto-optical images with low contrast and strong magnetic field noises, the weld seam center position could be extracted accurately. Experimental results at different welding speeds indicated that the absolute mean error of weld seam is about 0.015 mm, and the error measured by BP neural network decrease about 28% than that detected directly by magneto-optimal imaging. The compensation technique for magneto-optical imaging by BP neural network can be applied to detect the micro-gap weld seam accurately. It provides a novel approach for automatic identification and tracking of the micro-gap weld during the laser welding.

Key words: micro-gap weld; magneto-optical imaging; neural network; correct

A novel zero-weld-thinning friction sir welding process WANG Min, ZHANG Huijie, ZHANG Xiao, YU Tao, YANG Guangxin (State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, Shenyang 110016, China). pp 37-40

Abstract: A novel zero-weld-thinning (ZWT) friction stir welding (FSW) process was successfully developed, which can fundamentally eliminate the reduction of weld thickness commonly appeared in conventional FSW. The high-quality ZWT-FSW joints of aluminum alloys can be obtained at low cost and high efficiency without any addition or reduction treatment of base material before or after welding. The results indicated that the strength factor of 97% and the elongation factor of 100% can be obtained during the tensile test of ZWT-FSW joints. Additionally, an increase in the homogeneity of microstructures and mechanical properties can be achieved in weld thickness direction because shoulder effect on base material during FSW was weakened.

Key words: zero weld thinning; friction stir welding; weld formation; microstructure; mechanical properties

Residual stress in friction stir welded joint of dissimilar Al alloys between 5083 and 6082 with SWRXD technology ZHANG Jin, JI Pengfei, ZHOU Jun (Institute for Advanced Materials and Technology, University of Science and Technology Beijing, Beijing 100083, China). pp 41-45

Abstract: Dissimilar Al alloys of 5083 and 6082 Al alloys were welded by friction stir welding (FSW) with butt joint. With short-wavelength X-Ray diffractometer (SWXRD), measuring directions of residual stress for {311} and {111} crystal planes were respectively determined by analyzing the outmost circle data of pole figures. Then, welding residual stress of center layer in FSW plate was investigated by d_0 method. The results show that the longitudinal stress distribution on {311} crystal plane is similar to that on {111} crystal plane, while the two peak values of tensile stress appear in weld zone. Compared with {311} crystal plane, the measuring data on {111} crystal plane are more scattered. There is a relatively large difference of transverse residual stress between {111} and {311} crystal planes.

Key words: friction stir welding; 5083/6082 dissimilar Al alloys; short-wave length X-ray diffraction technology; residual stress

Effects of taper and thread number of stir pin on weld metal migration in FSW of thick aluminum ZHAO Yida, KE Liming, LIU Fencheng, MAO Yuqing (National Defense Key Disciplines Laboratory of Light Alloy Processing Science and Technology, Nanchang HangKong University, Nanchang 330063, China). pp 46-50

Abstract: The effects of the taper and the thread number of the stir pin on the plastic metal transfer in the weld transverse section during friction stir welding process were investigated by using aluminum alloy 2024-T4 with the thickness of 20mm. The

results show that, the volume of the high temperature metal migrated with the thread of the stirring pin increases with the increase of the thread number on the stir pin when the stir tool is rotated one round. The transfer extents of the plasticized metal in the nugget at the advancing side and retreating side increase in weld thickness direction. That is to say, the height, width and transverse section area of the weld nugget increase in the macroscopic view. When the taper of the stir pin is decreased from 25° to 15°, the amount of the plasticized metal in weld increase, and the transfer extents of plasticized metal on transverse and axial direction increase, and the area of weld nugget also increases. Therefore, when a stir pin with multiple threads or smaller taper is used, the problems of the large temperature gradient at the direction of the plate thickness and the insufficient metal migration in the weld for thick plate FSW can be overcome and the metallurgical quality of the weld can be guaranteed.

Key words: friction stir weld; thread number; taper of the stir pin; thick aluminum; weld metal migration

Analysis of microstructure and corrosion resistance of X80 pipeline steel welded by shielded metal arc welding

ZHAO Wei[1,2], ZOU Yong[1], XIA Dianxiu[3], ZOU Zengda[1] (1. Key Laboratory for Liquid-solid Structural Evolution & Processing of Materials, Ministry of Education, Shandong University, Jinan 250061, China; 2. School of Mechanical & Automotive Engineering, Qilu University of Technology, Jinan 250353, China; 3. School of Mechanical Engineering, University of Jinan, Jinan 250022, China). pp 51-54

Abstract: X80 pipeline steel was welded by twin electrode arc welding technology, and the composition, microstructure, corrosion resistance of welded joint were studied and compared with those of traditional arc welding. The deposition efficiency of twin electrode arc welding is higher than that of the traditional electrode arc welding, however, the concentration of alloying elements in welding material is lower because of the gravity coefficient of coating and its special structure. In addition, the concentration of polygonal ferrite is higher in welding material. What's more, the microstructure of CGHAZ is much finer because of the lower heat input for base material, which is beneficial to the promotion of the properties. The corrosion resistance of weld metal and CGHAZ is inferior to that of base metal in 0.5 M Na_2CO_3-1 M $NaHCO_3$ solution and NACE A solution with saturated CO_2. However, the twin electrode arc welding facilitates the corrosion resistance of weld metal and CGHAZ compared with the traditional arc welding.

Key words: twin electrode arc welding; X80 pipeline steel; corrosion resistance

Effect of thermal spraying parameters on cracking and thermal cycling life of thermal barrier coatings

YU Zexin, YU Jingye, WU Liangmin, WANG Weize (Key Laboratory of Pressure Systems and Safety, Ministry of Education, East China University of Science and Technology, Shanghai 200237, China). pp 55-58

Abstract: Segmentation cracks can be formed in the top ceramic coatings of thermal barrier coating system by the thermal spraying process without any cooling. The crack system can strengthen the strain tolerance of ceramic coatings. Up to now, there are almost no systemic studies on the cracking, especially on the branch cracks. The quantitative effects of feeding rate and substrate preheating temperature were studied on the cracking in this paper. And the thermal cycling lifetimes of coatings with different cracking systems were compared. It was found that with the increase of feeding rate, the density of vertical cracks and length of branch cracks increase firstly and then decrease. The density of vertical cracks shows an increment tendency with the increase of substrate preheating temperature. However, the length of branch cracks increases firstly, and then shows a decreasing trend. It shows that the lifetime of the top ceramic coatings can be improved effectively through restraining the total length and number of branch cracks in coating and maintaining the density of segmentation cracks at a certain level.

Key words: thermal barrier coating; branch crack; segmentation crack; thermal cycle

Analysis of droplet transfer and weld appearance in pulsed wire feeding MIG welding

ZHU Xiaoyang[1], LI Huan[1], HUANG Chaoqun[1], YANG Ke[1], NI Yanbing[2], WANG Guodong[2] (1. Tianjin Key Laboratory of Advanced Joining Technology, Tianjin University, Tianjin 300072, China; 2. School of Mechanical Engineering, Tianjin University, Tianjin 300072, China). pp 59-63

Abstract: On the basis of MIG welding with constant wire feeding speed, the pulsed wire feeding MIG welding system was built up. The waveform of welding current and arc voltage were acquired through synchronous electrical signal acquisition system and the arc behavior and metal transfer processes were monitored by high-speed camera. The effect of pulsed wire feeding on MIG welding process was studied. It is found that the axial mechanical force on the droplet is the key factor on the form of the droplet transfer. In the same pulsed wire feeding frequency, the droplet transfer forms at the base value and the peak value of the pulsed wire feeding speed are different. And with the change of the pulsed wire feeding frequency, the droplet transfer modes are also different. Additionally, the weld width of pulsed wire feeding MIG welding is wider than that of constant speed wire feeding MIG welding, and the weld width increases with the increase of the pulsed wire feeding frequency.

Key words: pulsed wire feeding MIG welding; pulsed wire feeding frequency; droplet transfer; droplet forces analysis; weld appearance

pared with that of the conventional welding and the grain size can be fined by about one level and much more uniform.

Key words: UPPW; TC4; thin plate welding; residual strain; grain size

Effect of post-weld heat treatment on microstructure and mechanical properties of welded joint of 7075 aluminum alloy by double-pulsed metal inert-gas welding process

LIU Changjun[1,2], LIU Zhengjun[1], RUAN Xianggang[2], HE Sizuo[1], SU Yunhai[1] (1. School of Material Science and Engineering, Shenyang University of Technology, Shenyang 110870, China; 2. School of Chemical Equipment, Shenyang University of Technology, Liaoyang 111003, China). pp 81-84, 88

Abstract: Double-pulsed metal inert-gas welding was used to weld AA7075-T651 aluminum alloy, and the welding samples was treated by solid solution treatment (480 ℃ × 50 min) and water quenching, then double-aging heat treatment (80 ℃ × 24 h) + (120 ℃ × 24 h). The effects of post weld heat treatment (PWHT) on microstructure and mechanical properties of welded joints were investigated by means of optical microscopy (OM), scanning electron microscopy (SEM), X-ray diffraction analysis, tensile test and micro-hardness measurement. The results shows that the grains are changed from dendrite to isometric crystal, and the non-equilibrium second phase is dissolved , the grain boundary becomes narrower and finer after post-weld heat treatment, and the microstructure characteristics of the welded joint are improved obviously. After heat treatment, the tensile strength of the welded joint increases from 342.5 MPa to 490 MPa, and the strength coefficient of the welded joint is up to 0.872. The micro-hardness of the weld softening zone is greatly improved, and the mechanical properties of the welded joint are significantly improved.

Key words: double-pulse; post-weld heat treatment; microstructure; joint strength efficiency; soften zone

Microhardness and microstructure of laser cladding layer on 3Cr13 kitchen knife by disc laser coaxial powder

YIN Yan[1], LI Zilin[1], XU Guangwei[1], ZHANG Ruihua[2,3], QU Yuebo[2,3] (1. State Key Laboratory of Advanced Processing and Recycling of Nonferrous Metals, Lanzhou University of Technology, Lanzhou 730050, China; 2. China Iron & Steel Research Institute Group, Beijing 100081, China; 3. Hardware Knife Cut Industrial Technology Research Institute Yangjiang, Yangjiang 529533, China). pp 85-88

Abstract: For the problems such as low hardness, poor wear resistance and short service life, the laser cladding technology was used to improve the performance of 3Cr13 stainless steel kitchen knife. The microstructure and microhardness of the laser cladding layer were studied. The results show that the laser cladding layer without porosity, crack and inclusions can be obtained with the optimized laser cladding process, which is well bonded with the substrate. The microhardness of the laser cladding layer fluctuates between 7.0 ~ 12.0 GPa. The average microhardness is about 9.0 GPa, which is about 2.3 times of that of the substrate. The hardness of the blade is greatly increased. The laser cladding layer contains a lot of hard WC particles, which are not melted. The unmelted WC particles embedd into relatively soft 304L matrix. This structure has a toughening buffer effect on the WC particles. Therefore it ensures that the WC particle is not easy to fall off when cutting tools is used. Thus the work ability of the cutting tools can be improved.

Key words: 3Cr13 stainless steel; laser cladding; microstructure; microhardness

Lorentz force solution and its influence on GMAW welding simulation

WU Jiazhou, ZHANG Hua, LI Yulong, JIA Jianping (Key Laboratory of Robot & Welding Automation of Jiangxi, Nanchang University, Nanchang 330031, China). pp 89-92

Abstract: Lorentz force formula was obtained using two methods, and verified by the welding simulation. Two kinds of methods to solve the Lorentz force were deduced in detail, and numerical simulation of droplet transition and arc characteristics were conducted by ANSYS software. Additionally, distribution of radial Lorentz force, images of droplet transformation and isotherm of welding arc were analyzed by comparing the simulation results. Results show that the indirect method has much better effects on results of the numerical simulation, and the distribution of Lorentz force is more close to the theoretical analysis owing to the magnetic vector analysis compared to the direct integral method. The calculated arc has not been compressed effectively, and the neck of droplet has not been also shrunk without Lorenz force source terms. Furthermore, the indirect method has a wider application prospect.

Key words: welding simulation; Lorentz force; tip effect; droplet; arc

Effects of welding parameters on ultra-narrow gap welding hot cracking

GONG Lian, ZHU Liang, ZHOU Chao (State Key Laboratory of Advanced Processing and Recycling of Nonferrous Metals, Lanzhou University of Technology, Lanzhou 730050, China). pp 93-96

Abstract: Hot cracking is a defect appearing easily In ultra-narrow gap welding. By using ultra-narrow gap welding with flux strips constrainting arc test, the effects of welding parameters and gap width on the hot cracking were studied. The result showed that the relationship between aspect factor of weld with heat input and that with gap width are the main factors to determine the hot cracking. At smaller aspect factor of weld and larger heat input, the tendency of hot cracking is larger, and with the

decrease of the gap width, the hot cracking tendency significantly increase. When the aspect factor of weld increase to a critical value, the welding hot cracking will not occurred, and the critical value is gradually increased with the increase of heat input, while gradually decreased with the increase of the gap width.

Key words: ultra-narrow gap welding; hot cracking; aspect factor of weld; heat input; gap width

Application of improved Otsu algorithm to welding image segmentation QI Jiyang, LI Jinyan, LU Zhenyun, WEI Sai (School of Mechanical Engineering, Jiangsu University of Science and Technology, Zhenjiang 212003, China). pp 97-100

Abstract: Because the welding image has too much gray level and information and serious interference from the arc, splash and others which reduces welding image contrast and blurs some image details, a newly-improved Otsu algorithm was proposedto accurately extract weld seam region from welding image. By replacing the mean value with variance, the algorithm was foundedto improve the image segmentation quality and reduce processing time, and the interclass variance and intraclass variance were also taken into considerations. The experimental results show that the proposed algorithm achieves good welding image segmentation effect with the less time. Compared with the other algorithms, it has obvious advantage and it is an effective and efficient algorithmof welding image segmentation .

Key words: image segmentation; weld seam image; threshold selection

Research on AC inverter power supply for resistance seam welding LI Yuanbo, ZHANG Chi, ZHOU Leilei, CHEN Long (College of Mechanical and Electrical Engineering, Guangdong University of Technology, Guangzhou 510006, China). pp 101-104

Abstract: The traditional AC power supply of seam welding has the shortages of low heat efficiency, long Zero-Crossing Timing as well as welding heat. In order to overcome these shortcomings, a new type of AC inverter welding power supply was developed. The power supply, whose inverter switch signals are generated by STM32 internal pulse modulation module, takes the 32 bit microcontroller STM32F103RCT6 as the main control core and works with sampling system to realize the goal of accurate control by the way of PI algorithm. The main power circuit, the inverter control mode along with the hardware and software design of the control system about the AC seam welding power supply were studied in details. The results indicate that the AC seam welding power supply is reasonable and reliable, which boasts fast dynamic responding, adjustable frequency, high stability as well as excellent performance of constant-current control, which is suitable for micro precision seam welding.

Key words: seam welding power supply; AC inverter; constant current control

FE simulation of effect of material mechanical parameters on welding stress and strain treated by ultrasonic impact

JIA Cuiling[1,2], CHEN Furong[1] (1. College of Materials Science and Engineering, Inner Mongolia University of Technology, Hohhot 010051, China, 2. Engineering Training Center, Inner Mongolia University of Technology, Hohhot 010051, China). pp 105-108

Abstract: The finite element model of different material mechanics treated by ultrasonic impact was established based on finite element software ABAQUS to explore their influences on welding stress and strain. The effects of elastic modulus, poisson ś ratio and the initial yield strength of material on stress and strain were discussed, respectively. The results show that elastic modulus, poisson ratio and initial yield strength of material can affect the stress and strain. With the increase of elastic modulus, compressive stress of x direction can increases, while the equivalent plastic strain decreases. With the increase of poisson ratio, stress of x direction and equivalent plastic strain will increase, but the effect of the poisson ratio on the equivalent plastic strain is greater than that on x direction stress. With the increase of the initial yield strength, stress of x direction will increase, and the equivalent plastic strain decreases significantly.

Key words: ultrasonic impact treatment; elasticity modulus; poisson ratio; initial yield strength; finite element simulation

Influence of TiO_2 activating flux on acoustic emission effect in pulsed laser beam welding of stainless steel LUO Yi[1,2], XIE Xiaojian[1,2], HAN Jingtao[1], ZHU Liang[1], WAN Rui[2], ZHU Yang[2] (1. School of Materials and Engineering, Chongqing University of Technology, Chongqing 400054, China; 2. Chongqing Municipal Engineering Research Center of Institutions of Higher Education for Special Welding Materials and Technology, Chongqing 400054, China). pp 109-112

Abstract: The structure-borne acoustic emission (AE) signals during activating flux pulsed laser beam welding of stainless steel were detected in real-time. According to the AE signals, the characterization method of plasma flume information and the mechanism of activating flux welding were studied. The results showed that the TiO_2 activating flux improves the absorption to laser energy, which reinforces the energy intensity of plasma in welding process and increases the heat transfer to materials. The behavior of plasma was tested and evaluated by AE signals of plasma detected in activating flux welding process. The calculation about AE count of plasma AE signals, root mean square (RMS) waveforms and power spectrum distribution reflect the improvement of plasma energy intensity in activating flux pulsed laser beam welding.

Key words: activating flux; pulsed laser beam welding; plasma; acoustic emission

Research on residual distortion of welded tubular structure based on FEA LIU Lu[1,2], WANG Ping[1], LIU Yong[1], MA Ran[1], FANG Hongyuan[1] (1. State Key Laboratory of Advanced Welding and Joining, Harbin Institute of Technology, Harbin 150001, China; 2. School of Materials Science and Engineering, Jiangsu University of Science and Technology, Zhenjiang 212003, China). pp 113-116

Abstract: In order to figure out the residual distortion of welded tubular structure, a thermal-elastic-plastic model using commercial FEA software MSC. Marc was established by considering material nonlinearity and geometry nonlinearity. The active and death element method was employed to simulate the welding process of shell plate and two tubes at different locations, respectively. The results show that the welded tube exists swelling distortion with its axial line offset, and buckling deformation occurs in the shell plate near weld. Before simulation, the rationality of the input parameters were discussed by comparing the experimental and simulated results of butt joint in three aspects of thermal cycles, longitudinal and transverse residual stresses of certain locations and angular distortion.

Key words: tubular structure; welding residual distortion; thermal-elastic-plastic FEM

Vacuum diffusion brazing of SiCp/Al composites LIU Shiyan, ZHANG Lixia, QI Junlei, FENG Jicai (State Key Laboratory of Advanced Welding and Joining, Harbin Institute of Technology, Harbin 150001, China). pp 117-120

Abstract: Vacuum diffusion brazing of SiC particle reinforced aluminum matrix was performed with Al/Cu/Al composite foils. The microstructure of the joint was investigated by SEM, EDS and XRD. The formation mechanism of the joints was analyzed according to Al-Cu binary phase diagram. The effects of brazing temperature on the interfacial microstructure and shear strength were studied. The results shows that as the brazing temperature rise from 590 ℃ to 640 ℃, the interfacial products change from Al_2Cu + αAl eutectic structure to discontinuous Al_2Cu intermetallic compound. The diffusion distance of liquid into base materials increase and the shear strength of joints increases and then decreases with brazing parameters. When the brazing temperature is 620 ℃, the holding time is 10 min and the bonding pressure is 1 MPa, the shear strength of the joints is up to the maximum value of 69 MPa.

Key words: SiC particle reinforced aluminum matrix; diffusion brazing; interface structure; shear strength

Porosity defects of 2219 aluminum alloy intersection weld by FSW and VPPAW SUN Zhaofan[1], CAI Donghong[2], YANG Xudong[2], LIN Zheng[3], WANG Song[3], HUANG Muchun[3] (1. College of Materials Science and Technology, Chongqing University of Technology, Chongqing 400054, China; 2. AMET Welding Automation Technology (Beijing) Co. Ltd., Beijing 102202, China; 3. Chongqing Institute of Optic and Machine, Chongqing 401123, China). pp 121-124

Abstract: FSW-VPPA intersection weld on 2219 aluminum of 6 mm in thickness was perpendicularly conducted by friction stir welding (FSW) and variable polarity plasma arc (VPPA) welding and it is found that there are porosity defects in cross-connectors. Therefore, porosity defects of 2219 aluminum alloy intersection weld by FSW and VPPA were analyzed to determine the type of porosities. The effects of welding parameters such as FSW heat input and VPPA welding speed on the porosity defects were compared and analyzed. The results show that the degree of porosity defects of cross-weld joint decreases with the FSW heat input being increased, which is due to the transient cavity formed in the FSW process. However, the degree of porosity defects of cross-joint increases with VPPA welding speed being increased. In order to reduce the degree of porosity defects of cross-joint, some measures had been taken, such as insert gas shielding, increase of the FSW heat input and reduction of VPPA welding speed appropriately.

Key words: FSW; VPPA; cross-weld joint; porosity defect

Microstructure and mechanical properties of TIG welded-brazed joint of pre-coating titanium and aluminum alloy CUI Qinglong (Engineering Research Center of Extreme Precision Optics, Fine Mechanics and Physics, Changchun Institute of Optics, Chinese Academy of Sciences, Changchun 130033, China). pp 125-128

Abstract: The titanium alloy plate was hot-dipped pure aluminum coating by the position of groove, then the pre-coating titanium alloy was joined to aluminum alloy by TIG welding-brazing. Comparison was made between the uncoated and coated joint to analyze interfacial structure and the strength of weld seam. The test results showed that, the same component $TiAl_3$ formed under two kinds of interface conditions. There is a interface reaction layer with the thickness of 4 ~ 6 μm in the non-coating joint, and the average tensile strength of the joint is 11 8 MPa, brittle fracture is the main fracture mode in tensile test. And the pre-coating joint has the interface reaction layer with the thickness of 2 μm, the average tensile strength of the joint is 205 MPa, and the fracture mode is ductile fracture. The introduction of coating can make the intermetallic compound layer thinner and the fracture mode be changed.

Key words: hot-dipping; dissimilar alloys; TIG welding-brazing; fracture mechanism