MAIN TOPICS, ABSTRACTS & KEY WORDS

Effect of Consequent Post Heat Treatment on the Joints in Precise Pulse Resistance Butt Welding ZHAO Xi-hua (Jilin University, Changchun 130022, China), HAN Li-jun, ZHAO Let. p1-4

Abstract: This paper studies the effect of consequent post heat treatment on the mechanical property and shape memory ratio Of the welded TiNi joints in TiNi shape memory alloy Precise pulse resistance butt welding, analyzes the joint structures and fractographies affecting mechanical property and shape memory ratio of welded joint by using strength testing, SEM and TEM, gets the optimum welding parameters obtaining good shape recovery ratio welded joint, and has discovered the inherent reason for proper consequent post heat treatment to promote the joint shape recovery ratio from microcosmic point. This is a base to exploit and develop TiNi shape memory alloy, and has great theoretical and practical values.

Key words: TiNi shape memory alloy; consequent post heat treatment; shape recovery ratio; strength tensile

On-line Quality Monitoring in Robot Arc Welding Process YE Feng (South-China University of Technology, Guangzhou 510640, China), SONG Yong-lun, LI Di, CHEN Fu-gen. p5-7

Abstract: In robot arc welding process, occasional disturbance will lead to uneven welding quality and weld defects. The on-line welding quality monitoring becomes one of the most heeded technology in the production industry especially in the automobile component manufacture. In this paper, a technology for on-line monitoring weld quality in robot arc welding process is described. It is based on the are signal features in the welding position, heat input and defects, to get the weld quality information and to evaluate if it is acceptable. It is important for "zero defect" quality control in robot welding production.

Key words: arc welding robot; weld; quality; information

The Principle and Micro-structure of Gradient Liquid Phase Sintering of Thermal Spray Coating QIU Chang-jun (Central-South Institute of Technology, Hengyang 421001, China), LIU Rut-lin. p8~10

Abstract: In this paper, the non-synchronous phenomenon of temperature distribution in space and time in compact metal-power sintering are discussed, it indicate that the gradient design for thermal spray coating sintering is necessary. The basic condition of gradient liquid phase sintering, the micro-structure and the poperty of coating bonding are discussed. The results show that the liquid phase sintering necessary for coating stability can be realized by gradient designing, the viscous flow of ordinary liquid phase sintering can be avoided, the oxide in micro-structure tend to assembling, and there is a clear liquid-solid phase boundary line in the surface of coating.

Key words: thermal spary coating; gradient liquid phase sintering; principle; micro-structure

Heated Band Width Criterion in Local Post Weld Heat Treatment of Three Dimensional Tubular Joint LU Hao (Shanghai JiaotongUniv., Shanghai 200030, China), WANG Jian-hua, MURAKAWA Hidekazu. p11~14

Abstract: A direct quantitative method has been proposed to assess the effectiveness of stress relief for tubular joint in local post weld heat treatment (PWHT). The three-dimensional welding residual stress and temperature fields in local PWHT are constructed. The characteristics of stress distribution in local PWHT for tubular joints have been studied using visco-elastic-plastic FEM. The welding stress distributions in single pass welding of different welding condition are quite similar. The different welding sequences don't have much influence on the location of the peak value stress. The degree of welding stress relief in hot spots of tubular joint under different condition of local PWHT has been analyzed. The residual stress is greatly lessened with increase of the heated band width in local PWHT. The relations between the heated band width and the stress of circumferential and axial components are quite different, the optimum heated band widths for circumferential and axial component are 3.46 $\sqrt{Rt}$ and 4.8 $\sqrt{Rt}$. With computation of main processing parameters in local PWHT, a criterion of heated band width has been recommended for the concurrent tubular joint in lcoal PWHT.

Key words: tubular joint; local post weld heat treatment; visco- elastic-plastic FEM; heated band width

Micro-bonding Behavior in the Weld Zone of Diffusion Welding for Aluminum Matrix Compete Reinforced with Particle LIU Liming (Dalian University of Technology, Dalian 116024, China), XU Weiping, YANG Dejun, WU lin, NIU Ji-tai. p15~18

Abstract: For diffusion wleding of aluminum matrix composite Al_2O_3p/6061 Al, the micro-bonding behavior of weld zone between reinforcement and matrix (R-M), reinforcement and reinforcement (R-R) was investigated. The results showed that key processing parameters af-fecting the micro-bonding behavior in the weld zone was diffusion welding temperature. The micro-bonding of R-M and R-R was weak bonding when welding temperature was below the solidus of composites. Bonding of R-M was achieved when welding temperature was between liquidus and solidus of composites, then liquid matrix metal appeared on the bonding interface. At the same time, liquid metal infiltrated the bonding zone of R-R, and the contact of R-R transformed into the bonding of R-M-R, thus the joint strength was improved obviously. It was found that there was a "critical temperature" between the solid and liquidus temperature of composites.

Key words: aluminum matrix composite; diffusion welding; matrix; reinforcement

Automatic Recognition Software System for Metal Transfer of the Metal Gas Arc Welding HAN Guo-ming (Tianjin University, Tianjin 300072, China), YUN Shao-hui, LI Jun-yue. p19~23

Abstract: On the basis of pattern recognition principle and method, an automatic recognition software for metal transfer of the metal gas are welding (MIG. MAG. CO_2) is successfully developed with Visual Basic language under the environment of Windows. A lot of spectrum of the metal transfer mode of metal gas are welding have been acquired in characteristic spectrum by testing. According to the relationship between the metal transfer type and spectrums, and geometrical pattern features of waveform of line spectrum, the data are pre-treated, several key characteristic pacameters are extracted, and the correspondent recognition function and a minimum - distance classifier have been constructed. The results show that using this system, the pattern recognition system of the metal transfer made for MIG. MAG. CO_2 welding can be done automatically. It has good accuracy and recognition precision. This software system provided the basis for controling the metal gas arc welding metal transfer automatically.

Key words: metal transfer; spectrum; computer; pattern recognition; software system

Experimental Investigation on Induction Brazing of Diamond Grinding Wheel WU Zhi-bin (Nanjing University of Aeronautics & Astronautics, Nanjing 210016, China), XU Hong-jun, XIAO Bing. P24~26

Abstract: This paper briefly introduces the technological advantages of a brazed monolayer superabrasive grinding wheel. It must be an inevitable tendency to replace the traditional electroplated grinding wheel in the future due to its excellent grindability. Because of the prospects in wide application of this grinding wheel, there can be no turning back in developing this wheel in our country. In this paper the strong bonding between the steel base and diamond was performed by induction brazing under the controlled temperature and time. The filled intermediate layer materials are reactive metal Cr powder and Ag-Cu alloy foil. The results show that the achromium carbide film has been formed on the interface between the diamond and the filled intermediate layer. It can be considered that the metallurgical bonding has formed in the interface between diamond-intermediate. Finally, it is proved through the grinding experimental tests.

Key words: abrasive wheel; monolayer; brazed grinding wheel; diamond

The Closed-loop Real-time Controlling of Short-circuiting Transfer in CO_2 Arc Welding LI Huan, (Tianjin University, Tianjin 300072, China), LI Jun-yue, YANG Li-jun, ZHANC Bao-hong. p27~30

Abstract: In this paper, an idea of closed-loop real-time controlling of short-circuiting transfer is proposed and is experimentally studied for decreasing the spatter in the short-circuiting transfer process of the CO_2 welding. At the two moments when spatter is most easily produced-short circuiting between droplet and welding puddle and the liquid bridge exploding-welding current is reduced in time by the method of high power element switching the resistance which is in settes connection with the welding circuit. At the former moment, a low current is held until the droplet fully contacts with the welding pool. At the later moment, another low current is held until the droplet transfer ends, and the large spatter caused by the incipient short circuiting and the small spatter caused by electrical explosion can be obviously reduced. The closed-loop real-time control of short-circuiting transfer process of CO_2 welding is realized.

Key words: CO_2short circuiting transfer; welding spatter; real-time control

Laser Welding of Two Super-fine Grain Steels PENG Yun (Tsinghua University, Beijing 100084, China), WANG Cheng, CHEN Wu-zhu, TIAN Zhi-ling. p31~35

Abstract: The strength and toughness of super-fine grain steels are greatly increased because of its micrometer or sub-micrometer grade grain size. In this paper the weldability of super-fine gum steels and characteristics of laser welding are discussed, the experiments of laser welding of super-fine grain steels are carried out, and the results of laser welding are compared with those of MAG welding and plasma arc welding. The coarse grain zones of laser welded joint of super-fine grain steel show good toughness. The hardening tendency of coarse grain zones is reduced if a low laser power and a slow welding speed are adopted. The tensile strength of laser welded joint of SS400 steel, which was rolled at higher temperature, is higher than that of parent metal. The welded joint of deeply rolled steel, which was work-hardened, has softening zones of recrystallization. The tensile strength of the joint is not affected if the softening zones are narrow. The laser welded joints of both SS400 steel and work-hardeened steel have good bending ductility.

Key words: super-fine grain steel; weldability; laser welding; microstructure; mechanical property

FEM Analysis or Spot Welding Process in Autobody Manutacturing

LIN Zhong-qin (Shanghai Jiaotong University, Shanghai 200030, Chi-

na), HU Min, LAI Xin-min, CHEN Guan-long. p36 ~ 40

Abstract: In the process of autobody assembly, the gap between the sheet metal parts introduced by the variations of stamping, location or fixturing is inevitable. As the most widely used joining style, spot welding makes the variation stack up. According to the characteristics of the autobody assembly, the 1/2 axisymmetric model is proposed and the finite element method is applied to analyze the contacting problem and assembly deformation under the squeezing force and electrothermal process. The contact distributions among electrodes and parts and the transient thermal analysis are fulfilled counting for the effects of the gap. The conclusion is provided for the simplification of the autobody assembly variation analysis.

Key words: autobody; assembly variation; spot welding

Pulsed MIG Welding Inverter Power Source by Spectral and Control System YANG Li-jun(Tianjin University, Tianjin 300072, China), LI Huan, HU Sheng-gang, LI Jun-yue. p41 ~ 44

Abstract: According to the character about spectral control of droplet transfer in pulsed MIC welding, a pulsed MIG welding inverter power source with the IGBT double single-end positive-exited inverting circuit and its control unit are developed. The control unit takes 8098 single chip computer to be able to quickly process spectral data as control center and the control center is connected with PWM control of welding current. Its control signal comes from a kind of are spectral signal reflecting droplet transfer. The experiments show that the power source and its control unit have the function, such as quickly collecting and processing spectral signal, good dynamic characteristic and easily on-line adjusting parameter. It has realized the control aim of 1 -peak-0-base droplet transfer and becomes good base of the next test of spectrum control method of droplet transfer in pulsed MIG welding.

Key words: droplet transfer; arc spectral information; pulsed MIG welding inverter; automatic control

A New Arc Length Tracing Method for Precison Pulse TIG Welding SUN Zhen-guo(Tsinghua University, Beijing 100084, China), CHEN Nian, CHEN Qiang, XU Xu-jiong, LUO Deng-feng, LIAO Jian-xiong. p45 ~ 48

Abstract: Based on the investigation of the relationship between the are voltage and the are length in small current pulse TIG welding, a new are length sensing and control method has been put forward and realized with hardware circuits. Then, an arc length tracing system has been established. The experimental results proved that the are length could be controlled over a larger current range both in the pulse TIG welding and in the DC TIG welding. When the average current is 20A and the given tracing length is 1 mm, the static are length tracing error is ± 0. 1 mm. The developed system has high control accuracy, fast dynamic response, high operation reliability. Adopting this method, the arc length tracing problem, which exists in welding processes of thin stainless components with complicated curved surface, has been solved successfully, while such problem couldn't be satisfactorily solved by the conventional arc length tracing methods.

Key words: pulse TIG welding; arc length sensing; arc length tracing

Heat Treatment Technology of the Dissimilar Materials' Friction Welded Joints of the Geological Drill Pipe FU Li (Northwestern Polytechnical University, Xi'an 710072, China), DU Shui-geng, LIU Xiaowen. p49 ~ 52

Abstract: In this paper, the drill pipe and its tie-in are welded by friction welding successfully. It's the first time to introduce friction welding technology into the geological drill pipe's production. The influence of different post weld heat treatment conditions on the microstructures and mechanical properties of friction welded joints between drill pipe DZ60 steel and its tie-in 40Cr steel has been discussed. Meanwhile, the microstructures and mechanical properties of friction welded drill pipes have been compared with those of hot-upsetting drill pipes. As a result, the conventional mechanical properties of drill pipes' friction welded joints have exceeded the values of geological drill pipe (DZ60) that specified by the technical criterions of Geological and Mining Department, and also are greater than that of the hot-upsetting geological drill pipes. Moreover, the results showed that the tensile strength and yield strength of friction welded joints can be improved efficiently if the appropriate tempering condition was adopted. Besides, the mechanical property values will be equal to or exceed the technical standard values of geological drill pipe (DZ60). The technology presented in this paper has been applied in practical geological drill pipe's Production, which can simplify the post weld heat treatment condition and also reduce the production costs.

Key words: geological drill pipe; dissimilar material; friction welding; mechanical properties; post weld heat treatment

Forming Mechanism of interface intermetallic Compounds for Difusion Bonding HE Peng (National Key Laboratory of Advanced Welding Production Technology, HIT, Harbin 150001, China), FENG Jicai, QIAN Yi-yu. p53 ~ 55

Abstract: The formation Of brittle intermetallic compounds at the interfaces of diffusion bonds is the main cause which lead to produce poor bond properties. Therefore, it is very important to research on and establish the formation and growing model Of intermetallic compounds at the interfaces for the control process of diffusion bonding. In this paper, according to the diffusion dynamics and the thermodynamics, the formation principle of interface intermetallic compounds for the multi-composition diffusion couple, the flux-energy principle, was put forward. In the light of diffusion theory, the formation capacity of the phase at the interfaces is determined by specific properties of the composition in the diffusion couple and the composition proportion of the formed phase is in agreement with the atom diffusion flux. In accordance with the flux-energy principle, the microstructure of the Ni/Ti interface is Ni/$TiNi_3$/TiNi/Ti_2 Ni/Ti. On the basis of this paper theory, multi intermetallic compounds with the equivalent flux-energy can be formed at the interfaces at the same time.

Key words: diffusion bonding; intermetallic compounds; atom diffusion flux

Microstructures and Oxidation Resistance of Fe_3Al Overlay by Manual Arc Surfacing MIN Xue-gang (Southeast University, Nan-jing 210096, China), YU Xin-quan, SUN Yang-shan, PANG Huai-xin. p56 ~ 58

Abstract: Using Fe_3Al electrodes by manual are surfacing, the Fe_3Al alloy was successfully deposited on a stainless steel surface. The overlaying processes, microstructures and oxidation resistance properties have been investigated and the results show that because of the innate brittleness of Fe_3Al, the Fe_3Al overlay with no appropriate treatment tended to crack. After 500℃ preheating the matrix and 700℃ postweld heat treatment, crack-free Fe_3Al overlay can be obtained. The loss of Al element during the welding is relatively large, but it didnt impair the oxidation resistance of the Fe_3Al overlay. After oxidized at 800℃ for 70h in static air, the Fe_3Al overlay was very slightly oxidized, but the oxidation of the stainless Steel matrix was severe.

Key words: Fe_3Al alloy; weld overlay; manual are surfacing (MAS); microstructure; oxidation resistance

Quality Control Visualization of Direct Current Spot Welder with Secondary Rectification LUO Xian-xing (Nanchang Institute of Aeronautical Technology, Nanchang 330034, China), JI Chun-tao, ZHANG Chen-shu, JI Dian-ying. p59 ~ 61

Abstract: Direct current spot welder with secondary rectification is more and more widely used in the industry because of its high power factor and balanced load on three phases. In spot welding of important assemblies, the visualization of quality control is helpful to the online welding quality evaluation. This paper discuses the soft ware realization of serial communication and welding current waveform display with VB6.0 on Personal computer, analyzes resulted waveforms such as that of the typical single pulse, typical dual pulse, single pulse per two cycles, and the effect of constant current control while power voltage increasing or decrea-sing. These waveforms directly explain the major characteristics and advantages of the three-phase secondary rectification. The developed system has been successfully used in the spot welding of aluminum frames of a large sized rocket. The welding current waveform displaying and filing system have become an important auxiliary quality evaluation measure for welding operators and quality inspectors.

Key words: spot welder; secondary rectification; welding current; visualitation; serial communication

Characteristics of Workhardening and Recrystallization of H08Mn2SiA steel NA Shun-sang (Hebei institute of Technology, Tangshan 063009, China). p62 ~ 64

Abstract: This paper introduces the characteristics Of workhardening and recrystallization of 0.08C 2Mn 1Si steel that widely used to CO_2 welding. In order to impress the changes of the characteristics of workhardening and the recrystallization of H08Mn2SiA steel, a regress method was adopted in experiment. The H08Mn2SiA steel has good characteristics of workhardening. The best temperature for the industrial technology of recrystallization is from 640℃ to 660℃. In order to shorten the time, it is possible for recrystallization temperature to heat steel ill 700℃ or higher temperature.

Key words: steel for CO_2 welding; workhardening; recrystallization

CAD Method for the Transition of Mn、Si of Coated Electrode YAO Shou-shan (Shanghai Jiaotong University, Shanghai 200030, China), LE Yang. p65 ~ 68

Abstract: In this paper, the regression method was taken in researching the relationships between the coating prescriptions and the alloyillg elements (especially Mn、Si) in the molten metal based on mass data of coating prescriptions and their transition elements in the molten metal. And a series of mathematical models for the transition of elements such as Mn、Si were established with the Visual Basic program language. The results show that it is a useful CAD method for the electrode design.

Keg words: electrode; transition of element; regression method; CAD

Determination of Moisture Content in Flux Using Electrical Capacidtance ZHU Liang (Gansu University of Technology, Lanzhou, China), ZHANG Ai-hua. p69 ~ 71

Abstract: Based on the fact that the dielectric constant of water is even higher than that of constituents Of fluxes, a capacitance condenser for fluxes has been designed. Electrical capacitance of fused type and sintered type fluxes was measured and correlated with the actual moisture content. Throngh regression analysis, the measwring results can be expressed as sigmoidal functions. The bond between the surface of fluxes granules and water molecules play an important role in the dielectric method of moisture measurement, the weaker bond is, the higher sensitivity of measurement is. The saturated moisture contenthas a correlation with hygroscopicity of fluxes. The electrical capacitance method of measuring the moisture content of fluxes is highly sensitive, rapid and suitable for on site measurement.

Key words: flux moisture content; dielectric constant; capacitance condenser; hygroscopicity

Arc Voltage Self optimizing Fuzzy Control System of Short-circuit Transfer Arc Welding under Carbon Dioxide WANG Ya-sheng (Xi'an Jiaotong University, Xi'an 710049, China), ZHANC Qing, CaiHong-neng. p72 ~ 74

Abstract: Unifying control of carbon dioxide are welding machine adjusts the welding current and voltage by turning one-knob only, chaff. ging current directly and corresponding arc voltage indirectly, to obtain the optimum match and ultimate short-circuit transfer frequency. However, the transfer process of

carbon dioxide short-circuit arc welding is difficult to be described in accurate model, and the unifying control method by traditional controlling theory is not realyy one-knob adjustment. Aimed at this issue, the authors present an arc voltage self-optimizing fuzzy control system of carbon dioxide short-circuinting transfer welding, its key component is a 16 bit 80C196KC single chip microcomputer, and the funzzy control is realized by software programming. to aim at the optimum result of ultimate frequency of short-circuiting transfer and according to the only selected value of welding current, the arc voltage can the automatically adjusted to the optimum value to really realize the unifying control of oneknob adjustment.

Key words: arc voltage; self-optimizing; fuzzy control; one-knob; short-circuiting transfer frequency

High-frequency Modulated Arc as an Ultrasonic Generator and Its Physical Property ZHANG Chun-lei (Tsinghua University, Beijing 100084, China), WU Min-sheng. p75~78

Abstract: Since conventional ultrasonic is inconvenient for application during welding process, a new method to emit ultrasonic has been proposed. With the addition of modulating signal to the TIG welding loop by the high-frequency power electronic switch inverting techniqUe, the arc-ultrasonic has been excited corresponding to the rising-edge and the descending-edge of the modulating electronic current. The amplitude of the signal recorded by the microphone is linearly proportional to the current if the based current is modulated by a small amount. The signals corresponding to the rising-edge and the descending-edge of the modulating electronic current can be separated if the pulse width of the modulating signal is big enough. The experimental results show that the V/I character of the modulated are is much more disordered. The mechanism of the arcultrasonic generation and some characters of the arc-ultrasonic are discussed by the wave eqUation and by the physical property of the modulated arc. The arc-excited ultrasonic has more advantages of controlling welding process and improving the quality of the weld in engineering.

Key words: ultrasonic emission; high-frequency modulation; arc physics

The Microstucture Calculation in the HAZ of Multipass Welds of New Type High Strength Sted LIN Wen-inn (Zhuzhou Electric Locomotive Works, Zhuzhou 412001, China), ZHOU Zhi-liang. p79~82

Abstract: In this paper, the authors have established a numerical calculation model of the HAZ of multipass welds of a new type high strength steel, according to the various structure of the new type high strength steel after varied heat circle. and calculated the size of local brittle zone (LBZ) in its HAZ. The calculated results accord well with the measured ones, the maximal error is 6. 69%. Based on what had been done, this paper discussed that main factors that influence LBZ. The results indict that: The weak POsition of the HAZ of multipass weds of new type high strength steel is 0. 2-0. 5mm from fusion line; The influence of welding linear energy on LBZ is seasonal, but generaly speaking, the linear energy about 20kJ/cm is advantaged to reduce LBZ; And preheat is advantage to reduce LBZ, and decreasing character temperature T1 and T3 are also helpful to prevent the happening of LBZ.

Key words: numerical calculation; the HAZ of multipass welds; LBZ

Computer Vision Sensing Technology and Its Application in Walding CHEN Qiang (Tsinghua University, Beijing 100084, China), SUN Zhen-guo. p83~90

Abstract: With the development of visual sensing, image processing and artificial intelligence, the computer vision has been widely used lit the field of welding, owing to its abundant information, high precision, generic application, and wide sensing range. In this paper, the state-of-the art of the computer vision sensing technology used in welding field has been introduced in brief, and the typical applications of this technology have been reviewed in detail. Based on the above, the exsiting problems, which impede its wider spread in welding, have been point out, the development tendency of computer vision sensing technology in welding has been prospected.

Key words: computer vision; image processing; welding

Advance of Researches on the Cold Cracking of the Gray Cast Iron Cold-welding with Homogenous Welding Consumables REN Zhen-an (Jinn University, Changchun 130025, China), ZHOU Zhen-feng, SUN Daqian. P91~96

Abstract: In this paper, the advance of researches on the cold cracking of the gray cast iron cold-welding with homgenous consumables both at home and abroad is summarized in four aspects including: (1) the effect of the graphite morphology and microsturcture of the weld on the cold cracking; (2) the mechanism of the cold cracking, and its initiation and propagation in the cast iron welds; (3) the research on the HAZ cold crack; (4) the development of the cold crack testing methods for the cast iron welded joints. These researches revealed: the crack resistance is much improved when the graphite is turned spheroidal from flake in the weld; the crack susceptibility of the gray cast iron weld can also be decreased by the twice stress-relaxation effecl of both bainitic and martensitic transformations; the crack is easily initiating and propagating at the narrow ferrite matrix bridge between neighbouring graphites; the effect of the diffusive hydrogen on the HAZ cold crack is less strong than that of the martensite transformation. The cold crack testing methods both the restraint cracking test and the plate rigid restraint cracking (PRRC) test for cast iron welds are emphasized because they can quantitatively evaluate the cracking resistance of the cast iron welds.

Key words: gray cast iron; cold crack; homogenous weld; arc cold-welding; research and development