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MAIN TOPICS, ABSTRACTS & KEY WORDS

Microstructure and Strengthening Mechanism of Light Beam Cladding Layer with Iron-based Self-fluxing Alloy Powder

SHAN Ji-guo (Department of Mechanical Engineering, Tsinghua University, Beijing 100084, China), DING Jian-chun, REN Jia-fe. p1~4

Abstract: Microstructure and phase structure of light beam cladding layer with iron-based self fluxing alloy powder were studied by SEM, EDS, X-ray diffraction, microhardness and Rockwell hardness. The results showed that the microstructure of Fe-Ni-Cr-Si-B alloy powder light beam cladding layer was composed of $\gamma(\text{Fe-Ni})$ dendrite which dissolved a lot of Cr and little B, Si, C, and $(\text{Cr, Fe})_7(\text{C, B})_3 + \gamma(\text{Fe-Ni})$ eutectic among dendrite. The macrohardness of the light beam cladding layer reached HRC47.3, which was higher than that of spraying layer and TIG cladding layer with the same powder. The main reason of strengthening of the light beam cladding layer was the solution of Cr, Si elements in γ phase and the precipitation of high hardness $(\text{Cr, Fe})_7(\text{C, B})_3$.

Key words: light beam cladding; microstructure; strengthening mechanism; iron-based self fluxing alloy powder

Mechanism of Improving Toughness of Self-shielded Flux-cored Wire

LI Zhuo-xin (Beijing Polytechnic University, Beijing 100022, China), CHEN Bang-gu. p5~8

Abstract: Self-shielded flux-cored wire is a welding consumable, which has been developed rapidly in the world but slowly in China. The key studies on SSFCE are focused on operative performance of the wire and the toughness of the deposited metal. In the paper, the composition, microstructure and properties of the deposited metal are investigated deeply through the addition of trace elements in the alloy system with higher Al content and controlling characteristic parameters of inclusion to obtain the microstructure with more acicular ferrite. The impact toughness of the deposited metal can reach 97 J at 0 °C. The results are useful for improving the toughness of the deposited metal with higher Al content.

Key words: self shielded flux-cored wire (SSFCE); impact toughness; inclusion

Numerical Simulation of 3D Liquid Surface Shape for Partial Penetrated Weld Pool

HE Jing-shan (National Key Laboratory of Advanced Welding

Production Technology, HIT, Harbin 150001, China), YANG Chun-li, LIN San-bao, WANG Qi-long. p9~12

Abstract: The qualitative analysis is carried out on the behavior of the partial penetrated weld pool with welding current changing from pulsed peak value to base value during pulsed TIG welding. The mathematical model of the liquid surface shape of partial penetrated weld pool is developed. The numerical simulation process based on this model is finished by Surface Evolver, a FEM simulation software. Both the simulation results and the model are then modified with experimental results. The modified model lays the foundation for systematical and qualitative simulating the principles of liquid surface of partial penetrated weld pool under various kinds of condition, and for obtaining the relationship between feature value of upper liquid surface and depth of weld pool.

Key words: partial penetrated weld pool; pulsed TIG welding; mathematical simulation

Laser Welding Mechanism and Parameters of Aluminum Matrix Composite

SiCw 6061Al LIU Li-ming (Department of Materials Engineering, Dalian University of Technology, Dalian 116024 P. R. China), ZHU Mei-h, XU Wei-ping, NIU Ji-tai. p13~16

Abstract: The weldability of the aluminum matrix composite SiCw/6061Al by pulse laser welding technique have been studied. The effects of laser output power (P), pulse frequency (f) on the properties of the welded joint has been investigated emphatically, and the microstructure of the welded joint has been analyzed by scanning electron microscopy, X-ray diffraction and transmission electron microscopy. The results show that the defects in the weld such as interface reactant and pore are the key factors to reduce the material weldability. The further investigations reveal that the interfacial reaction of reinforcement/matrix of the composite in the weld is inevitable at laser welding, the reactants are of directivity and grow in the direction of heat flow. The main welding parameter for affecting SiC-Al interface reaction is laser output power, and increasing the pulse frequency can restrain the interfacial reaction to some extent, and the amount of the pore in the weld would decrease or vanish with increasing the laser pulse frequency. On the basis of this the good weld for the aluminum matrix composite has been obtained by making proper welding processing parameters.

Key words aluminum matrix composite; laser welding

A Visual Sensor Based Weld Seam Tracking Method for Precision Pulse TIG

Welding CHEN Nian (Tsinghua University, Beijing 100084, China),

SUN Zhen-guo, CHEN Qiang, p17~20

Abstract: In order to solve the weld seam tracking problem in the pulse TIG welding process of some thin stainless steel workpiece with complicated curved surface, a high precision and rapidly responding speed seam tracking method based on visual sensor has been developed in this paper. According to the process characteristics of pulse TIG welding, special wavelength filter and reasonable exposure schedule have been selected, the clear and amplified welding image (from which weld seam, weld pool and tungsten electrode could be identified directly) could be acquired with industrial CCD camera. Then, an image processing algorithm has been programmed with Visual C language. With this algorithm, the central line of weld seam could be detected rapidly and precisely, the direction and distance which the tungsten electrode deviates from the central line of weld seam could be calculated out, the step motor has been driven to adjust the position of welding torch. Therefore, the precise and real time weld seam tracking has been realized. Experimental result shows that processing time for single image is less than 120 ms, the seam tracking could be carried out if the angle between welding direction and weld seam is no more than 30° . Finally, the thin stainless steel workpiece with complicated curved surface has been successfully welded using this method.

Key words visual image sensing; image processing; weld seam tracking; pulse TIG welding

Electric Field-assisted Anodic Bonding of Glass to Kovar Alloy

CHEN

Zheng (East China Shipbuilding Institute, 212003, China), K. Ikeuchi, M.

Takahashi, S. Nishikawa, p21~25

Abstract: Electric field-assisted anodic bonding of glass to Kovar alloy was performed at temperature 613 K under applied voltage 500 V. The interfaces were investigated by SEM observation and EPMA analyses. In order to determine the joint strength, shear tests were carried out. The results show that intimately contacted area between Kovar alloy and the glass enlarges from initial contact area with increase of bonding time. Na and K ions involved in the glass move toward the cathode from the anode surface under the electric field, resulting in depleted layers of the adjacent anode surface. The thickness of depleted layers increases with increasing bonding time. The stable joint strength of about 8~12 MPa can be achieved as long as $\approx 100\%$ intimately contacted area between Kovar alloy and the glass is obtained. These results are discussed by considering the inference of the applied electric field.

Key words anodic bonding; electrostatic force; intimate contact; ions drift; interfacial reaction; joint strength

Self-optimizing Intelligent Control of Current Waveform Parameters of CO₂

Gas Shielded Arc Welding YU Jian-rong (Beijing Institute of Petrochemical

Technology, Beijing 102600, China), JIANG Li-peis, SHI Yao-wu, p26~

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Abstract: A self-optimizing intelligent control algorithm of current wave-

form parameters of CO₂ gas shielded arc welding is put forward. The synthetic influence of the characteristic parameters of the CO₂ arc welding droplet short-circuit transfer process is taken into account in the control algorithm. The characteristic parameters synthetic value is taken for the quantitative evaluation and objective optimum function, which is used to describe and evaluate the short-circuit transfer process of CO₂ arc welding in real time. Based on the basic values of the waveform parameters, a three-stage fuzzy control algorithm is used to adjust and optimize the current waveform parameters to their optimum values. By this way, a two-input-three-output type fuzzy control system is turned into a two-input-single-output type fuzzy control system with multi-channel switch characteristic. Under the fuzzy self-optimizing of current waveform parameters during the short-circuit and at the stage of arc igniting, the waveform parameters and welding variables are adjusted progressively to a matching state. Thus, the droplet transfer of the welding process will be controlled, and the stability of the droplet transfer and the synthetic performance of the welding process can be improved.

Key words CO₂ gas shielded arc welding; current waveform; intelligent control

Study on Spot Welding Quality Monitoring Models by Linear Regression

Theory ZHANG Zhong-dian (National key laboratory of advanced welding

production technology, HIT, Harbin 150001, China), LI Dong-qing, YIN Xi-

ao-hui, p31~35

Abstract: By means of linear regression analysis technique, the single regression model and multiple regression model between dynamic resistance information in spot welding process of mild steel and quality parameters are studied systematically. Results show as follows: (1) The total linear relations of all models are obvious by statistic test, which shows that the regression models can be used for monitoring and controlling spot weld quality. (2) The determination coefficients of the single regression model are only from 0.15 to 0.33, and the determination coefficients of the multiple regression model can be raised from 0.59 to 0.79, which show that developing multi-variable synthetic monitor is an effective way to raise monitoring accuracy. (3) The relations between monitoring information and quality factors are substantially non-linear; it will make model more error to describe such relations by linear model.

Key words spot welding quality; monitoring model; linear regression analysis technique

The Characteristic Spectral Information of Droplet Transfer in Pulsed MIG

Welding and It's Applications YANG Yun-qiang (Tianjin University,

Tianjin 300072, China), LI Jun-yue, HU Sheng-gang, LIU Gang, LI Huan,

p36~38

Abstract: Pulsed MIG welding, which has character of easy to control heat input and droplet transfer during arc-welding, has become the focus of research work. The problem is how to obtain the characteristic information of droplet transfer during welding which has been still unsolved at present, as a result, it is difficult to control metal transition in loop way. After experiment in many ways, we finally get high Signal-to Noise (SNR) spectral information

of droplet transfer by the way of lowering the signal dimensions from pulsed MIG welding arc light. Results from our study show that the spectral information of droplet transfer is even more universal and stable under various condition of welding. At last, we have successfully efficiently controlled the droplet transfer of pulsed MIG welding and realized ODPF process using the spectral information.

Key words: pulsed MIG welding; droplet transfer; characteristic spectral information; automatic control.

Application of Neural Networks in Welding Parameters' s Planning of Robots

PENG Pai (Harbin Institute of Technology, Harbin 150001, China), WU Lin, TIAN JIN-Song, WAOG Xue-feng, FENG Ying-jun, p39~42

Abstract: Off line programming has become an important branch in robotic programming because it has many advantages such as wide applicability and not occupying production time. Welding parameters' planning is one of necessary components in Robotic Arc Welding Task-level Off Line System (RAWTOLS). In order to go on welding parameters' planning, a new training algorithm of the feed forward neural networks Single Parameter Dynamic Search algorithm is utilized. Single parameter dynamic search is the characteristic of this algorithm and therefore the calculation quantum of the objective function is reduced greatly. And the idea of functional link is used to preprocess the input of neural networks. The result of the calculation shows that the convergence effect of this method is better than BP algorithm in the field of welding parameters' planning.

Key words: off line programming; welding parameters' planning; neural network; single parameter dynamic search; functional link

On Thermo-mechanical Specification and Deformability of IN-718 Alloy in Friction Welding

LI Fu-guo (Northwestern Polytechnical University, Xi'an 710072, China), Zhang Mincong, Duan Liyu, ZHANG Tian-cang, p43~46

Abstract: Based on the study of the turbo disk and the compressor disk of high-quality aero engine, systematical analyses and calculation of the IN-718 superalloy simulated workpieces were carried out in this paper. The energy method is used to predict the behavior of IN-718 tubular specimens with an outside diameter of 11.5mm and inside diameter of 7.5mm during the friction welding and the closed form solution is presented for temperatures developed during heating in weld piece of finite. So theoretical equations of thermo-mechanical parameters can be easily got from the energy model. With the equations, curves of separating radius and instantaneous temperatures on different conditions are found. As result of it, the cause of cracks in the jointing of the welding zone is shown. As shown in this paper, the result can be used to lay down thermo-mechanical parameters scientifically and improve deformability of IN-718 superalloy in friction welding.

Key words: IN-718 superalloy; inertia friction welding; deformability; thermo-mechanical specification

Explosive Welding Test and Performance Study on Composite Sheet of Tool-Steel with Q235 Carbon-Steel

LU Ming (Nanjing PLA University of Sci-

ence & Technology, Nanjing 210007, China), WANG Yao-hua, YOU Jun, CAI Li-gen, p47~50

Abstract: The reasons of crack phenomenon and bad welding effect at four edges are analyzed, which tend to appear in the explosive welding of tool-steel and Q235 carbon-steel forming composite sheet. It is found that there are some connections among explosive speed, interface wave and shear intensity through test and study of the size and intensity distribution law of the composite sheet bonding interface, and also point out that not only the interface approximate to direct bonding (fine-wave bonding) has enough bonding intensity, but also its explosive load is smaller than others, and therefore it is the most desirable bonding. On the basis of tests and analyses, we have produced 36 pieces of composite sheets of T10 tool-steel bonded with Q235 carbon-steel whose sizes ranged from 0.5 m² to 1.5 m² by explosive welding technology. The bonding rate of welding beyond 98% and the performance of antibend and shear intensity are all satisfied for the sheets.

Key words: explosive welding; tool-steel; composite sheet

The Relationship Between the Processing Parameters and the Qualities of the Coatings Formed by Powder Feeding Laser Cladding

ZHANG Qing-mao

(Laser Processing Research Center, Mechanical Engineering Dept., Tsinghua University, Beijing 100084, China), ZHONG Min-lin, YANG Sen, LIU Wen-jin, p51~54

Abstract: The effects of the processing parameters of powder feeding laser cladding on the dilution of the Ni60A coatings were studied systematically. In order to explain the relationship between the powder feeding rate, scanning speed and the dilution, the concepts of the specific energy input E_r and the specific energy E_h formulated by L. C. Lim were introduced with their experimental measuring methods which have been proved successful. By varying the powder feeding rate and scanning speed under definite laser powder P and beam spot dimensions, coatings with different thickness were obtained. The calculation of the specific energy input E_r and the specific energy E_h was carried out on metallographical measurement. The explanation was given on the relationship between the processing parameters and the dilution. With the increase of the powder feeding rate and scanning speed, the dilution becomes smaller. In the meantime, it is the theoretical foundation for further study on the relationship between the microstructure, mechanism of solidification and the processing parameters.

Key words: laser cladding; dilution; processing parameter

Friction Stir Welding Technology of YL12 Alloys

LIU Xiao-wen

(Northwest Polytechnic University 710072, China), YAN Jun-hui, DU Sui-geng, p55~57

Abstract: Friction Stir Welding is a new and developing welding technology. With the vertical milling machine equipped with auxiliary fixtures, a lot of technological experiments on Friction Stir Welding of LY12 alloy had been done, and some theoretic information about the joint figuration was found. Preceding to the next step, the mechanism of Friction Stir Welding and the influence of the stirrer's shape, rotation speed and welding speed on joint quality were studied. The experiment result shows that when the thickness of

LY12 alloy is 4mm, the diameter rate of rotation tool shoulder and the welding pin with special profile is 3: 1, the rate of the diameter of the pin and the thickness of welded material is 1: 1, the welding speed is 37.5mm/min and the rotation speed is 2000r/min, a joint of high quality is formed. The result has laid a theoretical and experimental foundation for further research for Friction Stir Welding.

Key words: friction stir welding; aluminium alloy; technological research

Study on Elimination of Martensitic Shortness Layer for Dissimilar Steel Weld WANG Ai-zhen (Zhengzhou Light Industry College, Zhengzhou 450002, China), ZHANG Tai-chao ZHAO Hong-yan, 58 ~ 62

Abstract: In this paper the weldability of 1Cr18Ni9Ti and 15CrMo steels is analysed by magnetic recongnizer and scanning electromicroscope. Main factor of forming martensitic shortness layer is discovered in the weld at normal temperature and continuous high temperature. The effect law of different welding material and technology on ingredient and microstructure and performance of joint are discussed. And change law of martensitic shortness layer content at different state is also discussed. A effective method of pre-surfaced 8 mm thick transition layer of pearlitic new R417 electrode, then depositing austenitic A307 complex alloy on 15CrMo side beveled surface in 1Cr18Ni9Ti and 15CrMo joint has been created. This method has fully eliminated martensitic shortness layer of dissimilar steel joint at the normal temperature and high temperature. It solved welding problem of pipeline joint in ammonia synthetic tower and provided some reference for joint in other chemical pressure equipment.

Key words: austenitic steel; pearlitic steel; martensitic organization; shortness Layer

Joining Mechanism of Field-assisted Diffusion Bonding of Borosilicate Glass to Metals MENG Qing-sen (Institute of Welding of Xi'an Jiaotong University, Xi'an 710049, China), Yu Pin, Zhang Li-na, Xue jin, p63 ~ 65

Abstract: The features of microstructure in the bonding interface area of field-assisted diffusion bonding (FDB) of glass to metal have been studied, bonding mechanism and its influence factors have been analyzed by means of SEM, EDX and XRD, for which the bonding of electrolyte glass to monocrystal silicon and aluminum has been used as examples. The models of "metal-oxides-glass" of joining structure and ions diffusion bonding are indicated. A special bonding machine is used, voltage is 400 ~ 800 V, pressure is 0.05 ~ 1.0 MPa, temperature is 250 ~ 400 °C. The present study concludes that the joining forming is contributed by process of oxygen ions flowing and bonding with metal ions and deposited in the interface; the voltage, temperature, pressure and surface roughness of test wafers are influence factors for ions flowing and bonding; the pillar shape microstructure in the transitional area is favorable to bonding strength.

Key words: glass; metal; field-assisted diffusion bonding; transitional area.

Effects of Laser Shock Processing on The Mechanical Properties of Welded Joints(II) ZOU Shi-kun (Beijing Aeronautical Manufacturing Technology

Research Institute, Beijing 100024, China), WANG Jian, WANG Huaming, p66 ~ 68

Abstract: The welded zones of GH30 and 1Cr18Ni9Ti were shock-processed by pulse laser in last paper; the results showed that the limit strength of GH30 welded joints was increased by 12% but the effect on fatigue life was not obvious, at the meantime, the limit tensile strength of 1Cr18Ni9Ti welded joints was increased by only 5% but the fatigue life was increased by more than 300%. For further investigations, the distribution of microhardness and residual stress of welded zones were measured and the fatigue fractures were analyzed by SEM. After laser shock processing, the limit strength of GH30 welded joints and the microhardness in the surface layer were increased, surface residual compress stress was improved. Fatigue initiation and crack growth were held back and crack growth rates were reduced in the strengthened zones, but the shock spot did not cover the welded joints or HAZ entirely, unshocked zones did harm to the fatigue properties, martensite phase was formed in plasma welding 1Cr18Ni9Ti, which reduced the effect of strain deformation martensite induced by laser shock processing on the microhardness, so laser shock processing had less effect on the strength of 1Cr18Ni9Ti welded joints, but the surface residual compress stress gained by laser shock processing could obviously improve the fatigue life of 1Cr18Ni9Ti welded joints.

Key words: laser shock processing; welded joints; microhardness; residual stress; fatigue fracture

The Corrosion Behaviors of Welded Joints of 3C Carbon Hull Structural Steels WANG Su-hua (Institute of Naval Aviation Engineering, 264001, China), ZHU Mei-wu, KONG Xiao-dong, CHEN Xue-qun, p69 ~ 72

Abstract: Two kinds of carbon hull structural steels (the 3C steel which is Re-free and the 3C corrosion resistant steel which is modified by Re) and three kinds of welding consumables are selected and made into six kinds of welded joint specimen. The difference of corrosion behaviors of six welded joint specimen and distinct zones of the welded joint specimen have been investigated by means of laboratory stirring immersion test, dry-wet intermittent test and constant potential anodic dissolution test. Furthermore, combined with the metallurgical analysis, the reason which makes these corrosion results are discussed. The results indicate that the weld zone and base metal show more corrosive than the heat-affected zone(HAZ), while the weld zone is easier to corrode than the base metal. Not only is the corrosion resistance of structural steel improved itself with Re additions, but also the corrosion resistance of the steel welded joint is also improved correspondingly (compared to the same welding consumable). For Both the 3C steels which are Re-free and the 3C corrosion resistant steel which is modified by Re, the corrosion resistance of welded joint using J422 consumable is higher than using other two welding consumables.

Key words: carbon steel; welded joint; seawater; corrosion

Fluxless Pressure Soldering for SiC_w/6061Al Composites LI Shi-xiong (National Key Laboratory of Advanced Welding Production Technology, HIT 150001, China), YAN Jiu-chun, XU Zhi-wu, YANG Shi-qin, WU lin, YU Zhi-shui, p73 ~ 76

Abstract: A new soldering method—fluxless pressure soldering for $SiC_w/6061Al$ composites was presented, and welding experiments for the effects of two parameters: the soldering temperature and pressure related to soldered joint strength and microstructure were carried out by using the Zr-Al filler metal. The contribution of assistant process—scrape was also discussed. The experimental results show that temperature and pressure are two key soldering process parameters, when the soldering temperature is in the range of $400 \sim 450 \text{ }^\circ\text{C}$ and the pressure is 30 MPa, the tensile strength of soldered joint reaches $252.0 \sim 263.3 \text{ MPa}$, which is up to $85\% \sim 90\%$ of that of base metal. A number of microdimples, SiC_w whiskers, considerable quasicleavage together with residual pits of SiC whiskers are observed on the fracture, which identifies the reinforcement of SiC whiskers to the soldering seam. Moreover, the results of X-ray diffraction analysis indicate that the soldering seam mainly consists of $\alpha-Al(Zn)$ solid solution and uniform SiC whiskers.

Key words: aluminum matrix composite; soldering; pressure; microstructure

The Finite Difference Calculation of Carbon Migration in Dissimilar Metal Weldments YANG Hou-jun (Central China Power Corporation Group, Wuhan 430077, China), SHI Gang, ZHANG Ying-lin, LU Wen-guang, CAO Sheng, p77 ~ 80

Abstract: The analytic solution of carbon migration in dissimilar metal weldments (DMWs) had been researched by many researchers because of the idealization of assumed conditions, it caused bigger difference between the analytic and testing result. In this paper, numerical solution of carbon diffusion was solved and the finite difference method was used, inner boundary conditions of the meshes were treated using diffusional flux and carbon's activity, the stability and the convergence equation were discussed. The system of identification indicated that the numerical results were accordant to the experimental results.

Key words: DMWs; carbon migration; finite difference method; calculation.

Mathematical Model and Simulation on Dynamic Process of Droplet Short Circuiting Transfer ZHANG Jun-hong (Beijing University of Aeronautics and Astronautics, 100083, China), HUANG Shis-heng, p81 ~ 83

Abstract: It is a difficult task to study the many control parameters of waveform control method. In order to solve this problem, a mathematical model of the droplet short circuiting transfer dynamic process in CO_2 gas shielded arc welding is established. The developed model is converted into Simulink simulation model in software MATLAB and simulation of it is also made. Finally, to prove it, many experiments are conducted. The result indicates that the developed way of model is reasonable and the model is practicable. It also shows that the software MATLAB is a workable tool for the dynamic process of droplet short circuiting transfer.

Key words: CO_2 gas shielded arc welding; droplet short circuiting transfer; simulation model; dynamic process

A Study of SK6 Arc Welding Robot Offline Programming WANG Ke-hong (University Of Science And Technology Of Nanjing 210094, China), LIU Yan, XU Yue-lan, ZHOU Yi-ren, p84 ~ 86

Abstract: This paper is designed to research the system of offline-programming which consists of six subsystem of geometric modeling, welding orientation planning, welding parameter planning, robot program produced automatically, robot graph simulation and information transference. The interface of man and computer can be easily applied. This paper studies and redevelops MRCWORD soft system, and realizes arc welding robot program produced automatically and information transference of computer and robot. Test welding on a typical workpiece shows that the system is feasible, programming efficiency is advanced remarkably and the seam quality is satisfactory.

Key words: arc welding robot; offline programming; geometric model; all position weld

Study and Development of Assembly-Welding CAPP System for Welded Structures ZHU Zhi-ming (Tsinghua University, Beijing 100084, China), Zhang Chong-ke, Chen Bing-sen, p87 ~ 92

Abstract: Started with a brief introduction of the development of Computer Aided Process Planning (CAPP) system, this paper firstly included some new development trends of CAPP, such as integration, generalization and object-orientation. Then, the features of welded-structure assembly and welding process were analyzed, and how these features could affect the traditional design methods of CAPP system was explained. After all according to the actuality of welded-structures CAPP system, the features of welded-structure processing and the trends of CAPP system, some general principles and methods of how to construct a practical welded-structure CAPP system had been brought forward.

Key words: assembly-welding; computer aided process planning; welded structure; software developing technique

Development in the Research of Ultra Low Carbon Bainitic (ULCB) Welding Consumables XUE Xiao-huai (Institute of Metal Research, Chinese Academy of Sciences, Shenyang 110016, China), QIAN Bai-nian, GUO Xu-ming, YU Shao-fei, SHAN Yi-yin, p93 ~ 96

Abstract: This paper reviews the generation background and toughening and strengthening mechanism of the Ultra low Carbon Bainitic (ULCB) welding consumables, together with the effecting factors on the properties of weld metals. Both of the shielding gas and the welding process play an important role in the toughness of ULCB weld metals. Microstructures and hardness are insusceptibility to the cooling rates. The productivity should be settled when this consumables are extensively applied to industrial production. The properties will increase tremendously if efforts are made to control the size of the oxygen inclusions and destroy columnar grain structure in the weld metals.

Key words: ultra low carbon bainitic (ULCB); welding consumables; toughening and strengthening mechanism