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A Review of Physical Appearance of Molten Metal Droplet in Arc Welding Process

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Abstract: This fundamental research presents an overview of a molten metal flow in arc welding processes. This study presents a systematic review of the fluidity of molten drop in any surface concerning the investigation results. This paper consists of monochromatic imaging of a reflection of molten droplets, welding spectrum of a grating monochromator by high-speed imaging with a prism, reviewing of the physical mechanism of molten macro drops with implementing of hydroforming effect. Many research papers are being reviewed but a systematic review of molten droplets was missing in current research areas. However, the outcome of the study is to develop an overview structural idea of molten droplets.

Keywords: Drop, Molten, Overview, Review.

Introduction

C. Allemand says that the uses of monochromatic imaging are to provide a monochromatic 2-D image of an object which is made from polychromatic. Extending the wavelength from Ultraviolet (UV) to Infrared (IR), it is necessary to use reflector optics like mirror and reflection grating monochromator. The author describes that a method for producing a blur-free monochromatic 2-D image of a polychromatic object illuminated with, or emitting a continuous spectrum (C. Allemand et al.). Inoue proposed in his research that, with a grating monochromator, the spectrum of the welding arc and molten pool is measured. In this research, measurements of Carbon-dioxide (Co2) arc, Argon (Ar) arc, and molten pool all have the same peculiar spectrum respectively. The choice able combination of an image pickup tube and optical filter by the above-mentioned measurement results, allowing emphasizing the image of the molten pool and impound the image quality for welding process automation (I. Katsunori).Y. Ogawa says that the monochromatic technique is used to obtain the images of the object. The author says that, at the time of welding, a series of the high-speed camera with a special prism attached to the camera, which will help to get precise pictures of the molten welding fluid, along with their measurements. As a result, a time series of image data can also be processed like existing methods of analyzing in situ voltage and current signals in time and frequency domains (Y. Ogawa). J. Chapuis studied the evolution of the spreading of a large drop of liquid metal called macro-drop. The author proposed his objective that, to supply qualitative and quantitative information during the deposit of the liquid metal about process parameters. The qualitative and quantitative analysis of experimental data in such a basic configuration shows the potential of this approach. The author says that results are been analyzed in the light of process parameters to identify the physical mechanisms involved and appreciate their effects on the behavior of such a macro drop (J. Chapuis et al.). F. Gao proposed in their study that, some basic modes of precise deposition and solidification of molten micro drops. In this study it contains columnar (i.e; drop on the drop) deposition at both low and high

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frequencies, sweep deposition of continuous beads on flat surfaces, and repeated sweep deposition for a build-up of layer objects or materials (F. Gao et. al.). R. Li studied on droplet impact and equilibrium contact angle. The formation of this type of contact angle was investigated by experimentally studying the deposition of micro-size droplets of molten wax ink on cold solid surfaces. The author applied a thin silicon oil layer to the substrate surface was found to increase the equilibrium contact angle, but the solidification contact angle was found to be mainly influenced by the resistance of the oil layer to the motion of the droplet contact line (S. Chandra et al.). Y.C Lim studied the Non isothermal spreading of not traveling pulsed gas metal arc weld (GMAW-P) deposits were performed by experiments and numerical simulation. The author says that metal from the melting welding wire was deposited as a regular stream of droplets into a molten weld pool whose spreading was enhanced by direct arc heating of the solid substrate and weld pool convection. The author found that heat transfer and phase change are the factors that had less effect by the end of the spot weld time so, the weld pool spreading speed was controlled by the thermal diffusion in the liquid (Y.C Lim et al). The basic problem of the impact and solidification of molten droplets on a substrate is of central importance to a host of processes. The dynamic interaction between the oscillation in the liquid region and the rapid advance of the solidification front was visualized, quantified are studied by D. Atllinger in this paper. The author established that the wetting angle dynamics are strongly coupled to the evolution of the droplet free surface and no quantitative agreement with Hoffman's correlation was found (Z. Zhao et al.). S. Schiaffino studied as the formation and stability of smell scale beads deposited onto a solid surface by sweeping a droplet stream over it. The author discusses his research that, a molten bead forms with parallel contract lines which have been arrested by freezing while the bead itself it's still lately in a liquid state, and that the still-molten material is stable when the contact angle is less than ½ pi and unstable when it exceeds ½ pi. The author told that instead, a series of separate macro drops would form, each composed of a certain number of micro drops. Contact line arrest or at least hysteresis is a prerequisite for bead formation from liquid droplets (A. Sonin et al.). R.L Hoffman examined experimentally that, the shift factor is determined solely by the static contact angle between the liquid and the solid substrate. When interfacial forces between a solid and a liquid do not change as flow occurs, the shift factor is determined solely by the static contact angle between the liquid and the solid substrate. Although untested a technique is also suggested to obtain the shift factor for the system in which interfacial forces do change (R. L Hoffman et. al.). T. DebRoy says that fusion welding has many characters, which slows the parametric weld of having heat transfer and fluid flow, every absorption, vapor composition, etc. The interaction of the material and the heat source leads to rapid heating, melting, and vigorous circulation of the molten metal driven by buoyancy, surface tension, impingement or friction, and when an electric current is used by electromagnetic forces. The author says that the usual engineering mechanics treatment of material behavior assumes homogeneous properties, which is not appropriate for weldments. A new opportunity exists for developing theory and methodology for evaluating mechanical properties in the presence of various gradients (T. Debroy et al.). K.C Mills says that interfacial phenomenon occurs in many high-temperature processes such as steelmaking, welding, etc. The author discusses many characters' phenomena of slaying penetration, the formation of foams, electrowetting, etc. The author also explained in his research that, a surface break can be occurring in surface or interference can result from both gravitational and capillary forces (Z. Li et al.). A mathematical model is developed by H.G Fan, and he describes the globular transfer in gas metal arc welding (GMAW). This work is both theoretical and experimental. Using the volume-of-fluid (VOF) method, the fluid flow and heat transfer phenomena are dynamically studied during the following processes: droplet formation and detachment, impingement of a droplet on a solid substrate, impingement of multiple droplets on the molten pool, and solidification after the arc extinguishes. He-Ne laser, in conjunction with the shadow graphing technique, is used to observe the metal transfer processes. It is suggested that the droplet transfer frequency has a let on the substrate. The author says that a major influence on the weld-pool configuration and a higher frequency leads to deeper penetration. The author assembles a high-speed video camera to record the observations (H.G Fan et al.). M.C Cho researches that, according to mathematical models with parameters obtained from the analysis of high-speed video images and Data Acquisition (DAQ) system. The author performed and says that, the effectiveness of individual simulation parameters on heat and fluid flow in the molten weld pool and the final configuration of stationary welds. The author says that reducing total force and increasing arc pressure distribution radius both decreased the weld penetration because they produced a weld deposit that was more convex, which absorbed the momentum of impinging droplets (M. H Cho et. al.). E. Romero describes that an image analysis algorithm used to detect profiles during arc welding processes. The new algorithm is an aggregation of image processing (segmentation, filtering), computational geometry (alpha shape), and graph theory (cycle detection). The author says that it allows extracting precise geometrical profile entities, whether open or closed contours, which could be used for the monitoring of the welding process. The algorithm is shown to be efficient and could be used for real-time monitoring of the gas metal arc welding process. The author says that the algorithm for droplet detection can be directly used with the same optical settings for the real process when there is a relative motion between the wire and the weld pool. The author finds that the macro drop is useless but could be used to appreciate the back-arc profile of the weld pool (E. Romero et al.). A.L Biance discusses the first step of droplet spreading, he researches that a microscopic precursors film propagates ahead of the microscopic drop, which spreads on a solid wetted by this precursor. The author says that the dynamics of the droplet results from a balance between the spreading force and the viscosity. After, the experimental study, the Author tells that, inertial velocity is smaller than the vicious one, which implies the mill metric drop a viscosity typically smaller than 100 mPas. Water belongs to this category, but also many oils, most solvents, and liquid metals (D. Quere et al.). D. Quere experimented on the study of the bouncing droplet that seems as metaphors of wetting. The author says that the classical laws of wetting can be adapted to real surfaces, restricting the word "real" to "rough". He also says that the typical size of the drop can be comparable with the size of the pattern (D. Quere). H.B Chin says that his study was carried out on the stability of a long thread-like viscoelastic droplet suspended in a viscoelastic medium flowing through a cylindrical tube. The author says that droplet breakup was obtained in terms of the rheological properties of the fluids concerned, and the flow conditions. After the experiment of the author, he says that, along threadlike droplet cannot be stable under all disturbances, and that both the elastic and viscous properties affect the stability of extending droplets. The author tells that, an infinitesimally small sinusoidal disturbance will grow exponentially in time, the exponential factor being a function of the wave number. One element of indeterminacy in the theory is the size (i.e., amplitude) of the initial disturbance (H.B Chin et al.). Y.C tan proposed that a microfluidic device designed to generate monodispersed picoliter to femtoliter sized droplet emulsions at controlled rates.

Materials and Methods

This (Poly-di-methyl-siloxane) PDMS microfabricated device utilizes the geometry of the channel junctions in addition to the flow rates to control the droplet sizes. An expanding nozzle is used to control the breakup location of the droplet generation process. The droplet breakup occurs at a fixed point due to the focused velocity gradient created by the nozzle shape geometry. The system not only creates monodispersed primary droplets with sizes controlled by the applied flow rates but also generates monodispersed submicron droplets. The author says that the sizes of the primary and satellite droplets produced from this device are monodispersed and the dependency of droplet size on flow rates provides the dynamic controls over the encapsulated volume making them unique reaction vessels for chemicals of picoliter to nanoliter in volume (Y.C Tan et al.). V. Christini studies and says about the methods for droplet deformation, breakup, and coalescence inflows relevant to the design of microchannels for droplet generation and manipulation. Another way numerically reviewed by the author that, it can be applied for directly simulating droplet generation, dynamics, breakup, and coalescence in microchannels. The magnitude and type of flow are both important in determining generation, breakup and coalescence times, and droplet sizes. For droplets of a size comparable to the channel width, the hydrodynamic forces exerted by the wall on the drop may exceed those exerted by the imposed channel flow. The author says that, under these conditions, droplet deformation and droplet breakup and coalescence criteria and rates may be strongly affected (V. Cristini et al.).

Results and Discussion

This study presents an overview structural idea of physical appearance of molten droplets, this review tells about the different droplet breakage operation and their nozzle shape geometry.

Conclusions

In above mentioned papers, there is no way of involvement of any talks about the thermal cycle on strength in molten metal flow in gas metal arc welding, and also there is no talk about cooling rate on molten metal flow in gas metal arc welding.

Conflict of Interest: The authors declare that there are no conflicts of interest concerning the publication of this article.

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