# Preface

Pulse current gas metal arc welding (P-GMAW) is rapidly becoming a popular welding process in a large variety of industries engaged in weld fabrication of light to heavy sections of ferrous and nonferrous metals. In order to better understand the intricacies of P-GMAW, well-known welding researchers have registered their understandings from different points of view to explore its novelty in applications. Effective use of this welding process primarily involves understanding of the process parameters governing the behavior of metal transfer affecting thermal characteristics of the weld. The P-GMAW was initially well recognized as a unique process of hazard-free joining of relatively thin section with one drop transfer per pulse at a low heat input. The knowledge of controlling the characteristics of pulsed arc has lead to development of some innovative welding processes especially suitable to join sub-millimeter range thin sections of ferrous and nonferrous metals. But later on the enormous potential of P-GMAW process in precise control of weld characteristics could also be successfully used in weld fabrication of large variety of relatively heavy structures. This is primarily to join thick sections in different positions with better weld quality using multiple drop transfer per pulse at high deposition rate with low heat buildup in weld. However the implications of controlling the pulse parameters influencing these conditions under the multiple drop transfer per pulse are not yet systematically well understood. This book is exclusively dedicated to discuss the knowledge base developed to use the P-GMAW process for welding of practically every section size of ferrous and nonferrous materials at any position of engineering structure.

The multipurpose application of P-GMAW primarily requires the knowledge of designing and control of pulse form in order to manipulate energy input and its distribution in the process. To facilitate these kinds of welding operations with ease and comfort, by negotiating relatively larger number of pulse parameters, variety of user-friendly efficient power sources have been developed. They are dedicated to one knob control system of programmable power sources operating in non-synergic and synergic modes. However, regardless of all these facilities, the P-GMAW process is still handicapped to attract the welding fraternity for its large-scale use with unanimous choice and confidence. This is primarily because of deficiency of

knowledge about the rather complicated influence of each pulse parameters on weld quality when they simultaneously interact during operation. Paucity of knowledge especially exists to control the relatively large number of interactive process parameters in case of multiple drop transfer per pulse.

The use of comparatively higher energy makes the process control more critical with respect to regulation of its thermal behavior. Author and his coworkers have tried to analyze these aspects from various perspective of basic and applied nature in their untiring efforts of more than three decades. Getting an insight of this subject became possible after development of a concept of summarized influence of simultaneously interactive pulse parameters of welding operation. It has opened a scope for in-depth critical understanding of the process and its performance in the light of a summarized influence of pulse parameters defined by a hypothetical dimensionless factor *phi*. A relatively smooth understanding of P-GMAW process as a function of this factor explores ample scope of its use in innovative applications with desired weld quality, which was otherwise difficult. The knowledge of P-GMAW has been systematically handled in order to present the subject from basic understanding of the process control to critical aspects of welding metallurgy and joint properties. The book also covers some advanced concept of the control of pulsed current for application of GMAW in joining of extra thin sections of ferrous and nonferrous metals by application of appropriate mode of metal transfer. The knowledge of largely smooth correlations among the *phi*, process control, weld characteristics, and joint properties has been emerged to explore the development of computer-aided P-GMAW process to produce desired weld quality. In the background of the basic understandings about the control of high deposition P-GMAW, this book as a monograph has been planned to serve the academicians, researchers, and practitioners of welding engineering.

The first compilation of the basic to application-oriented understanding of high deposition pulse current GMAW process in the nine chapters of this monograph may serve as first-hand comprehensive knowledge to practice advanced welding engineering in prospective applications. It may give confidence to the shop floor welding engineer to handle this otherwise highly critical welding process with confidence. It may inspire the researcher to think further for more versatile application of unique nature of pulse current in GMAW process to develop cutting edge welding technology. The author is aware of many other fundamental issues of the P-GMAW process which remains uncovered in this book and he also duly apologizes for non-intentional oversight of many potential contributions of various researchers to refer in this book. All such deficiencies of this presentation are kept in mind to establish the potentials of P-GMAW more fundamentally in another write-up planned for near future.

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