机械工业出版社高水平著作出版基金资助项目

铸铁焊接冶金与工艺

周振丰 著

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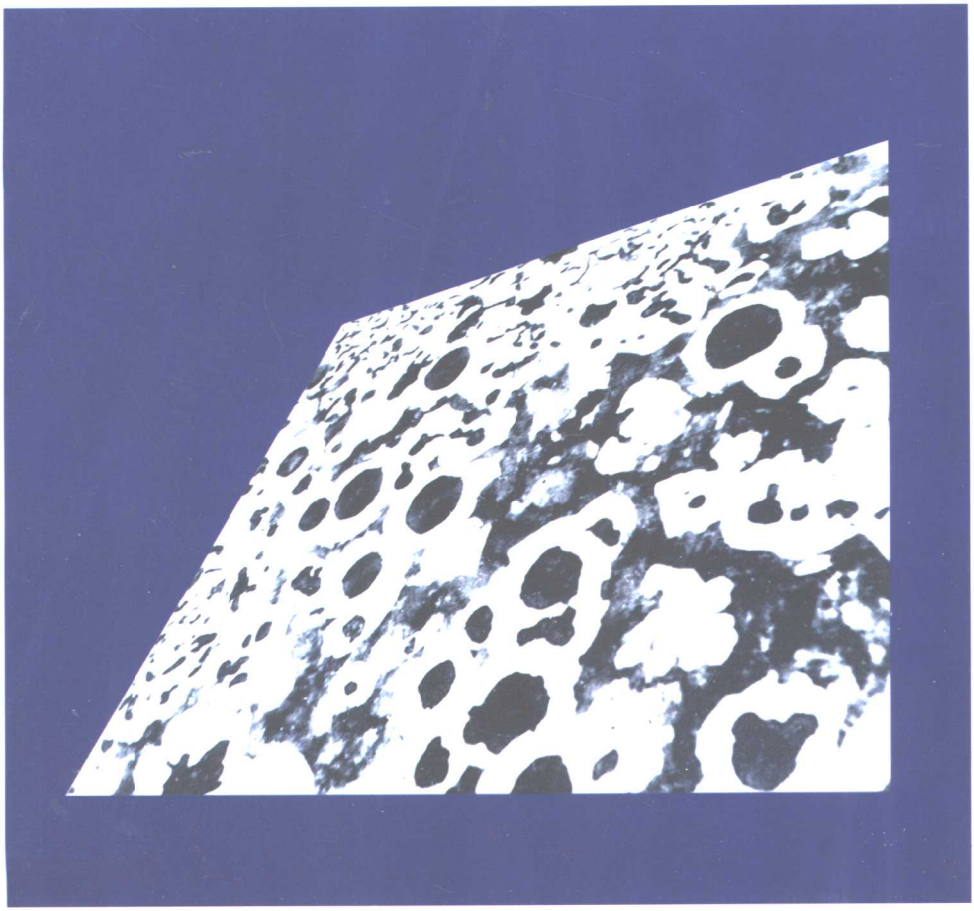
by ZHOU ZHENFENG



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本书是原吉林工业大学博士生导师周振丰教授撰写的一本学术专著。它主要汇集了周振丰教授30多年来在铸铁焊接冶金、材料及工艺方面的研究成果，同时为使我国铸铁焊接研究与应用尽快与国际接轨，也用适当篇幅介绍了国际上铸铁焊接冶金与工艺的新进展。

全书共8章，主要内容有：总论——铸铁分类及铸铁焊接概述；铸铁焊接热影响区的组织与性能；铸铁焊接的裂纹；灰铸铁的焊接；铁素体球墨铸铁、珠光体球墨铸铁的焊接；奥-贝球墨铸铁的焊接；蠕墨铸铁的焊接；白口铸铁、奥氏体铸铁、可锻铸铁的焊接。

本书可供从事焊接教学与科研的高校教师、研究生、博士生和科研院所与工厂的工程技术人员阅读。

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前　言

铸铁本质上是指 w（C）＞2.14%的铁碳合金。实际上，“铸铁”一词包括了不同石墨形态与基体组织的范围非常广泛的铸造合金。铸铁通常分为六种：灰铸铁、可锻铸铁、蠕虫状石墨铸铁（简称蠕墨铸铁）、球状石墨铸铁（简称球墨铸铁）、白口铸铁及奥氏体铸铁。每种铸铁按其基体组织与力学性能的不同又细分为不同牌号。

铸铁作为工程及结构材料在工业上获得了广泛的应用。

铸铁焊接主要应用于以下三个领域：

1. 在铸造厂铸件缺陷的焊补　中国现在每年的铸铁件产量约为800万t，其中10%～15%具有不同的铸造缺陷，需要用焊接进行焊补。焊接挽救了大量铸铁件并节约了大量资金。

2. 在使用中已损坏或磨损的铸铁件的焊补。这些铸铁件均已机械加工，价格昂贵，其修复的经济利益是明显的。

3. 焊接配件的生产　把铸铁件与其它铸铁件或其它金属进行焊接以生产配件可提供各自的优势，它已成为焊接界与铸造界许多人关注的热点课题。

铸铁的焊接性比低碳钢差很多。铸铁含碳、硅及硫、磷杂质的数量比低碳钢高得多，因此铸铁的塑性较差，并在焊接接头易形成碳化物及高碳马氏体。这两种组织都很脆，对形成冷裂纹很敏感。镍基焊缝由铸铁母材稀释而引起的杂质，如硫、磷，会提高其焊缝热裂纹敏感性。如何改进高强度珠光体球墨铸铁及奥-贝球墨铸铁的焊接接头强度也是值得研究的课题。

铸件修复及焊接配件生产中的大量焊接工作需要为此目的不断改进焊接工艺与焊接材料。为寻求优质的手工及机械化铸铁焊接工艺已经进行了大量的研究工作，在铸铁焊接冶金研究的基础上，铸铁焊接用的许多新材料已研究成功。

尽管铸铁焊接在工业中非常重要，但直到现在仍无一本广泛而深入地讨论铸铁焊接冶金与工艺的书出版。自1958年以来，作者主要从事铸铁焊接冶金与工艺的研究，并取得了很大的成功，在写本书时，作者不仅主要利用了自己的大量试验研究成果，而且从国际专业期刊中选取了铸铁焊接冶金与工艺新进展的精华。这第一本铸铁焊接冶金与工艺专著希望能完成上面提到的重要任务，并促进铸铁焊接的进一步研究与广泛应用。

诚挚欢迎有关本书的建议及批评。

PREFACE

Cast iron is essentially an iron-carbon alloy containing more than 2.14 wt% carbon. In fact, the term "cast iron" covers a very wide range of cast alloys with different shapes of graphite and matrix structures. Cast irons are usually divided into six basic types: gray cast iron, malleable cast iron, compacted graphite cast iron, nodular graphite cast iron, white cast iron and austenitic cast iron. Each type of cast iron is subdivided into various grades according to their matrix structure and mechanical properties.

Cast irons as engineering and structural materials have been used widely in industries.

The three major areas of application of welding to cast irons are:

1. Repair of casting defects in the foundry. The annual production of iron-castings now in China is about eight million matric tons, 10%～15% of them have different casting defects and are required to repair by welding. Welding saves a lot of iron-castings and economizes on a great deal of money.

2. Repair of iron-castings that have become damaged or worn in service. Different iron-castings that have become damaged or worn in service can often be repaired by welding. These castings usually had been machined and are expensive. The economic advantage of their repairing becomes apparent.

3. Production of welded assemblies. Production of assemblies by welding iron-castings to other iron-castings or to other metals offers several advantages. It becomes a hot spot subject of concern to many

people both in welding and casting communities.

Cast iron is considerably less weldable than low-carbon steel. Cast iron contains much more carbon, silicon and impurities (S. P) than does steel, with the result that cast iron is less ductile and tends to form carbide and high-carbon martensite in the welded joints. Both of these microstructures are very brittle and susceptible to cold cracking. Impurity elements, such as sulphur and phosphorus, obtained from the dilution of nickel-base weld by cast iron base metal increase the hot-cracking susceptibility of the weld. How to improve the joint strength of high-strength pearlitic and austempered cast iron is also worthwhile topic to study.

The large volume of welding jobs in the repair of castings and production of welded assemblies requires a continuous improvements of welding technology and welding consumbles for this purpose. A large number of research studies have been carried out to find high-quality technology for the manual and mechanized welding of cast iron. Many new welding consumables for cast iron have been developed on the basis of research on welding metallurgy of cast iron.

In spite of the great importance of cast iron welding in industries, until now there has been no book that comprehensively and thoroughly deals with the welding metallurgy and technology of cast iron. Since 1958 the author has engaged in research on welding metallurgy and technology of cast iron and has achieved great success. In writing this book the author not only mainly drew on his own extensive experimental and research work, but also extracted the essence of new advances on welding metallurgy and technology of cast iron from international professional periodicals. This first book devoted to the welding metallurgy and technology of cast iron is hoped to fulfill the above-mentioned vital mission and to promote

further study and widespread application of cast iron welding.

The author welcomes suggestions and comments pertaining to this book.

ZHOU ZHEN FENG

周振丰 1927年11月出生于江西。1950年毕业于北京北方交通大学，1953年于哈尔滨工业大学研究生毕业，是我国哈尔滨焊接研究所与我国第一个本科焊接专业(哈尔滨工业大学)的创建人之一。长春吉林大学材料科学与工程系教授、博士生导师。历任中国机械工程学会焊接学会副理事长，全国焊接专业教学指导委员会副主任(1986~1990)，原吉林工业大学材料科学与工程系主任(1982~1986)。长期从事焊接冶金研究工作，特别是铸铁焊接研究工作。主编的著作有：焊接冶金与金属焊接性，该书1992年获国家教委全国优秀教材奖。参编的著作有：焊接金相图谱，该书1990年获中国新闻出版署全国优秀科技图书二等奖，焊接手册第二卷等。先后获国家重大成果奖一项，部、省级科技进步奖7项。发表论文80余篇。1989年被评为全国教育系统劳动模范。1999年被纽约科学院选为院士。

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