

Preface

To save the non-recycled energy source and reduce CO₂ emission requires improving the efficiency of fossil power plants, which can be achieved by developing supercritical power plants. Heat-resistant steels are used in these plants, as well as potentially in future fusion power reactors.

This book cumulates over 6 years' of research by the authors on *9-12Cr Heat-Resistant Steels*, and many more years' experience in steel in general. It includes the more recent results, since 2009, but also covers relevant, recent work by other researchers around the world. Since 2009, the authors have carried out extensive research and have many research publications, listed separately in Bibliography. These research papers are the backbone of this book. In addition, other researchers' work are reviewed and the major results are highlighted and discussed. The book will cover both conventional heat-resistant steels and reduced-activation heat-resistant steels, the latter including nitride-strengthened steels.

There is a lack of recent books devoted exclusively to heat-resistant steels. Two related books published post-2000 are:

- (1) Fujio Abe, Torsten-Ulf Kern and R. Viswanathan (eds.), *Creep-resistant steels*, Woodhead Publishing Limited, 2008;
- (2) Ronald L. Klueh and Donald R. Harries, *High-chromium ferritic and martensitic steels for nuclear applications*, American Society for Testing and Materials, 2001.

There is no doubt that the editors and authors of those books were world authorities, in those topics, but the research field has advanced enormously since. From 2009 to 2014, included in the Science Citation Index (based on which data the journal impact factors are assembled) and Conference Proceedings Citation Index, more than 160 papers were published on heat-resistant steels topic, each year, from research carried out in more than 60 countries. Nearly 400 institutions and companies have contributed to this research area, during the last 2 years.

So, an updated and specialised book on this subject is very much needed and should be welcomed by researchers and industrialists alike.

Like in many other R&D fields, China has become the major force in the world. Of the research papers mentioned above, published since 2009, 29 % were written by Chinese authors, even higher than China's share in the world population. This is followed by Japan (12 %), Germany (8 %), Russia (7 %), USA (6 %), South Korea (5 %). Within this China force, Chinese Academy of Sciences, led by the group of the first four authors for this book, has been a major player.

The fifth author, Sha, in the UK, has been collaborating with the Chinese group since before 2009. See their joint research papers in the separate paper list, in Bibliography. Sha is an experienced book writer, and is a lead or sole author of four research books, all published in English. The last one, *Steels: from materials science to structural engineering*, was published by Springer in 2013. Within 2 months of its publication, researchers at University of Science and Technology Liaoning requested translating the book to Chinese. Springer obliged, and the Chinese version was published by Metallurgical Industry Press, Beijing, in August 2014.

Sha organised and completed the writing of the present book, though the main research was done in China.

The 9–12 %Cr ferritic/martensitic heat-resistant steels have been widely used in ultra-supercritical power plants because of the high thermal conductivity, low thermal expansion coefficient and low susceptibility to thermal fatigue. Reduced-activation ferritic/martensitic steels have been regarded as candidate structural materials of future fusion power reactors.

This book fills a gap in the recent book literature in heat-resistant steels, a hot topic in contemporary materials studies, whilst at the same time documents the latest research in this area. A large chunk of this latest research is from the authors themselves, based on their own experience in this area, but the book also covers important relevant research by others. The underlining structure of the book is based on the types of these steels, and then properties important to the application of these steels. Factors influencing these properties are explained, including microstructure and thermal ageing.

The book is primarily intended for researchers and users studying heat-resistant steels, but will be of interest to researchers and users of other types of steels, and the wider materials science and engineering, in general. To make each chapter self-contained, there is a small overlap across chapter contents.

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