TITANIUM
Physical Metallurgy
Processing and Applications

F.H. Froes, editor
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THE TITANIUM INDUSTRY has been in existence for approximately 60 years, and a great amount of information on the science and technology of this “wonder” metal has been compiled in that relatively short time. This reference book is based on an education course developed by ASM International in the early 1980s, which has been revised several times as new technical information became available, the latest revision in 2014 by F.H. (Sam) Froes, an expert in titanium and titanium alloy technology.

This book is a comprehensive compilation of the science and technology of titanium and its alloys. It details the history of the titanium industry and discusses various extraction processes, including the Kroll and Hunter processes and others. The fundamentals of solidification and phase diagrams are discussed, numerous detailed descriptions of beta (β)-to-alpha (α) transformations are included, and there are extensive discussions on processing, characteristics, and performance of the different classes of titanium alloys, including alpha (α), alpha-beta (α-β), beta (β), and intermetallic compounds. There are chapters devoted to alloying, deformation and recrystallization, mechanical properties and testing, and metallography. The following are also covered: melting and casting; forming of plate, sheet, strip, and tubing; joining; and machining. Practical aspects of primary and secondary processing are given, including a comprehensive description of superplastic forming. Details of expanding powder metallurgy techniques are included. The relationship of microstructure to mechanical properties is addressed in detail. A detailed description of corrosion behavior is included, and a comprehensive section on current applications of titanium and its alloys, documenting why certain alloys are used in various applications as well as their limitations, is also addressed.

Permeating the book are examples of how lowering the cost of titanium can lead to increased use. I believe that this book will be of considerable value to persons new to the industry as well as practitioners, and that it will significantly increase your knowledge of the science and technology of titanium.

Dr. F.H. (Sam) Froes
Tacoma, Washington, August 2014
Dr. F.H. (Sam) Froes has been involved in the titanium field for more than 40 years. After receiving a B.S. from Liverpool University, M.S. and Ph.D. degrees from Sheffield University, he was employed by a primary titanium producer, Crucible Steel Company, where he was leader of the Titanium Group. He spent time at the United States Air Force (USAF) Materials Laboratory, where he was a branch chief and supervisor of the Light Metals Group, which included titanium. While at the USAF Laboratory, Dr. Froes co-organized the landmark TMS-sponsored Conference on Titanium Powder Metallurgy in 1980. This was followed by 17 years at the University of Idaho, where he was director and department head of the Materials Science and Engineering Department. During this tenure, Dr. Froes was Chairman of the World Titanium Conference held in San Diego in 1992. He has over 800 publications, in excess of 60 patents, and has edited almost 30 books, the majority on various aspects of titanium. Recent publications include a comprehensive review of titanium powder metallurgy and an article on titanium additive manufacturing. He has organized more than 10 symposia on various aspects of titanium science and technology, including in recent years co-sponsorship of four TMS symposia on cost-effective titanium. Since the early 1980s, Dr. Froes has taught the ASM International education course “Titanium and Its Alloys.” He is an ASM Fellow, a member of the Russian Academy of Science, and was awarded the Service to Powder Metallurgy by the Metal Powder Association.