Shape Memory Alloy '86

Chu Youyi, T.Y. Hsu, and T. Ko
(China Academic Publishers, 1986)

The First International Symposium on Shape Memory Effects and Their Applications was held in Toronto in July 1975. The proceedings, published in *Shape Memory Effects in Alloys* and edited by J. Perkins, contains 32 papers. Since 1975, progress in basic understanding of SME and its applications has been significant. This is reflected in the volume under review, which is the proceedings of the International Symposium on Shape Memory Alloys held at Guilin, China, September 6–9, 1986, sponsored by the Nonferrous Metals Society of China and cosponsored by the Japan Institute of Metals.

This book contains 78 papers spanning the entire field of shape memory—from phenomenology and theory to manufacture and applications—and includes 15 invited papers. The first paper provides a brief but comprehensive account of basic and applications-oriented work on SMAs in China. This paper and many others in the book emphasize that serious R&D efforts are being made in China, particularly in medical applications of SME. The remaining papers are grouped into five broad sections: general theory (5 papers); nickel-titanium alloys (21 papers); copper-base alloys (25 papers); other SMAs and materials (4 papers); and applications, manufacture, testing, and related behavior (22 papers). The list of titles clearly shows that nickel-titanium alloys and copper-zinc-aluminum alloys are still the workhorse materials in SME.

The first section pertains to aging, thermal cycling, transformation hysteresis, transformation mechanisms, and stability of solitary waves in SMAs. A paper dealing with a model for simulation of material behavior of SMAs is also included. The second and third sections discuss topics such as crystallographic aspects of premartensitic and martensitic transformations, all-round and two-way shape memory effects, pseudoelastic behavior and reversion stresses, and effects of aging and rapid solidification in specific nickel-titanium and copper-base SMAs, respectively. The fourth section covers aspects of SME in specific iron-base alloys and gold-cadmium alloys.

While the first four sections mainly concern the science of SME, the fifth section deals primarily with shape memory technology. Apart from a few informative reports pertaining to manufacture and testing, the major thrust in this section is applications. A very wide range of proven, promising, and potential applications—industrial, medical, and cosmetic—are covered.

It is not surprising that the papers in this volume have differences in standards of quality, quantity of technical content, and clarity of presentation. Most, however, are informative and well written.

This volume is essential for those working in areas involving SME. It will also be useful to a wide spectrum of readers—physical metallurgists, mechanical engineers, condensed matter physicists, surgeons, dentists, and many others.

The symposium organizers and publishers must be congratulated for producing this volume with commendable promptness. However, the appearance of this otherwise excellent book could certainly have been improved. The reproduction of micrographs is particularly unsatisfactory. Since as-received manuscripts have been photographically reproduced, there is no uniformity in the text printing format. It may be worthwhile to publish a new edition having a more uniform appearance and containing both papers and a record of discussions held during the meeting.

Reviewer: P. Mukhopadhyay, an electron microscopist at the Bhabha Atomic Research Centre in Bombay, specializes in phase transformation and structure-property correlations.

Laser-Beam Interactions with Materials

Martin von Allmen
(Springer-Verlag, 1987)

This book, published as a second monograph in the Springer-Verlag Materials Science series, is based on the author's graduate-level lectures in applied physics at the University of Bern, Germany. Covering the principles and fundamentals of a variety of applications in laser-solid interaction, it provides, at a very readable level, a good foundation for extended, in-depth reading in related fields. The book deals with laser effects in metals, insulators, and semiconductors, with particular emphasis on technologically important materials and structures, and on physical insights rather than specific processes.

The book consists of five chapters and one appendix. The introduction in the first chapter is succinct, but could have given more detailed descriptions of historical perspective and the scientific and technological importance of laser-material interactions.

The next chapter deals with the fundamentals of light absorption processes in solids (metals, nonmetals, insulators, and semiconductors). Special attention is given to effects, both linear and nonlinear, derived in the matter under the interaction with intense light beams. This chapter provides a good basis of understanding for ensuing chapters on applications such as heating and melting. It describes the subjects without involving too many equations, and is very readable to anyone who understands basic physics.

The third chapter is devoted to solid-state thermal heating processing by laser light. Some analytical calculations are given of sample temperature under the various conditions of irradiation and sample response. Processes of annealing, crystallization, compound synthesis, and transformation hardening, are treated as the applications of current interest.

The fourth chapter deals with melting and solidification in general. It covers the fundamental subjects of heat flow, thermodynamics, nucleation and kinetics, then focuses on the regrowth processes of ion-implanted substrates, recrystallization of semiconductors on insulators, surface alloying on metallic and semiconductor substrates, and melt quenching for glass formation.

The last chapter discusses the energetics of laser effects, such as evaporation and ionization. The laser irradiance is allowed to exceed the window values of heating and melting to induce gas phase species. In order to provide some insight into these phenomena, the chapter begins with the fundamentals of thermodynamics and kinetics of evaporation, gas breakdown, and ionization phenomena. In terms of practices, it deals with drilling, welding, and cutting of materials. Phenomena at moderate irradiance and at very high irradiance are also treated. The latter part especially concerns the production of hot and dense plasma to achieve thermonuclear fusion, x-rays and fast ions. The treatment of this part is not as extensive as other areas.

The appendix is particularly useful. It provides some heat-flow equations including Greens functions and numerical solutions; selective material data such as optical absorption length, reflection, and optical breakdown threshold; and thermodynamic data including various units and symbols. The reference list at the end of the book, neatly indexed by chapter-coded numbers, allows ready access to the citation or to the material covered in the text.

This volume is highly recommended to both graduate students and material scientists and engineers who are actively involved or interested in laser-material interactions. The book will serve as a resource for those seeking either introductory material in related fields or a handy reference to laser-solid interaction.

Reviewers: El-Hang Lee and Clif W. Draper are both on the staff at the AT&T Engineering Research Center, Optical Technology Department, Princeton, NJ.