

Table of Contents

Preface, Committee and Sponsors

Chapter 1: Theory of Martensitic Transformations

Fundamental Achievements of the Dynamic Theory of Reconstructive Martensitic Transformations

M.P. Kashchenko and V.G. Chashchina 3

Stress-Free Strains in Martensitic Microstructures

M. Peigney 10

Phase Stability at Martensitic Transformation in Zr-Based Shape Memory Intermetallics

G. Firstov, A. Timoshevski, Y. Koval, S. Yablonovski and J. Van Humbeeck 15

About the Mechanism of Deformation at Martensite Transformation in the Fe-31 wt%Ni Alloy

V. Gundyrev and V. Zel'dovich 20

Effect of Titanium Carbide Inclusions on Morphology of Low-Carbon Steel Martensite

H.A. Pham, T. Ohba, S. Morito, T. Hayashi, T. Furuhashi and G. Miyamoto 25

Chapter 2: Thermodynamics and Kinetics of Martensitic Transformations

Superelasticity of Single Crystalline Fe-30.8 at.%Pd Alloy

F. Xiao, K. Yashima, T. Fukuda and T. Kakeshita 33

Effect of Partial Thermal Cycles on Non-Chemical Free Energy Contributions in Polycrystalline Cu-Al-Be Shape Memory Alloy

L. Daróczy, T. El Rasasi and D.L. Beke 38

Calorimetric Study of Avalanche Criticality in the Martensitic Phase Transition of $\text{Cu}_{67.64}\text{Zn}_{16.71}\text{Al}_{15.65}$

M.C. Gallardo, F.J. Romero, J. Manchado, J.M. Martín Olalla, A. Planes, E. Vives, E.K.H. Salje, R. Romero and M. Stipcich 46

Reactive Stresses and Burst Character of Shape Memory Deformation in Single Crystals Cu-Al-Ni and Ni-Fe-Ga Single Crystals

V.I. Nikolaev, G.A. Malygin, S.A. Pulnev, P.N. Yakushev and V.M. Egorov 51

Electric Resistivity as Phase Volume Fractions Indicator in Metastable Alloys

L. Saint Sulpice, M. Lakrit, S.A. Chirani and S. Calloch 56

Chapter 3: Crystal Structure, Texture and Defects in Materials with Martensitic Transformations

Nano- and Microcrystal Investigations of Precipitates, Interfaces and Strain Fields in Ni-Ti-Nb by Various TEM Techniques

D. Schryvers, H. Shi, G.T. Martinez, S. Van Aert, J. Frenzel and J. Van Humbeeck 65

High Temperature Martensitic Transformation and Shape Memory Behavior in HfIr Intermetallic Compound

Y.N. Koval, G. Firstov and V.V. Odnosum 72

In Situ Tensile Deformation of TRIP Steel / Mg-PSZ Composites

A. Weidner, H. Berek, C. Segel, C.G. Aneziris and H. Biermann 77

Tension - Compression Asymmetry in $\text{Co}_{49}\text{Ni}_{21}\text{Ga}_{30}$ High-Temperature Shape Memory Alloy Single Crystals

T. Niendorf, J. Dadda, J. Lackmann, J.A. Monroe, I. Karaman, E. Panchenko, H.E. Karaca and H.J. Maier 82

In Situ X-Ray Study of Phase Transformations in Ti-Nb-Based SMA under Variable Stress-Temperature Conditions: Preliminary Results

S. Dubinskiy, V. Brailovski, S. Prokoshkin and K. Inaekyan 87

Distribution of Residual Elastic Microstress in Rolled Ti-Ni Single Crystals Y. Perlovich, M. Isaenkova, V. Fesenko and T. Dementyeva	92
Low Temperature Transformations in β-Metastable Ti 5553 Titanium Alloy A. Settefrati, E. Aeby-Gautier, B. Appolaire, M. Dehmas, G. Geandier and G. Khelifati	97
Neutron Diffraction Study of a Non-Stoichiometric Ni-Mn-Ga MSM Alloy P. Ari-Gur, V. Ovidiu Garlea, A. Coke, Y.L. Ge, I. Aaltio, S.P. Hannula, H.B. Cao, A.S.B. Madiligama and V. Koledov	103
The Influence of Nanocrystalline Structure of Iron on α-ϵ Phase Transformations under Pressure V.P. Pilyugin, A. Patselov, T. Tolmachev, E. Chernyshov, A. Ancharov and D. Brytkov	108
EM Characterization of Precipitates in as-Cast and Annealed Ni_{45.5}Ti_{45.5}Nb₉ Shape Memory Alloys H. Shi, J. Frenzel and D. Schryvers	113
Twinning in Ti-48%Ni-2%Fe Single Crystals under Rolling M. Isaenkova, Y. Perlovich, V. Fesenko and T. Dementyeva	118
Phase Transformations and Shape Memory Effect in Alloys of Zr-Ni-Co System T. Kosorukova, G. Firstov, Y. Koval, V. Ivanchenko and J. Van Humbeeck	123
XPS and NEXAFS Investigation of Electronic Energy Structure of Ti-Ni and TiNi-Cu Alloys B. Senkovskiy, D. Usachov, A. Chikina, P. Ulyanov, A. Shelyakov and V.K. Adamchuk	128

Chapter 4: Theory and Modeling of Mechanical and Functional Properties

Dynamical Behavior of Martensite-Austenite Transitions: Simulations and Experiments M.F. Laguna, I.G. Aguilar, P.A. Larochette and J.L. Pelegrina	137
The Self-Accommodation and Rearrangement of Martensite Multi-Variants under Cyclic Stress: Phase-Field Simulation Y.G. Cui, J.F. Wan, J. Man, Z.H. Guo, J.H. Zhang and Y.H. Rong	143
Simulation of Vibration Isolation by Shape Memory Alloy Springs Using a Microstructural Model of Shape Memory Alloy A.E. Volkov, M.E. Evard, A.V. Vikulenkov and E.S. Uspenskiy	150
Precursor Nanoscale Textures in Ferroelastics: Interplay between Anisotropy and Disorder T. Castán, A. Planes and A. Saxena	155
Implementation of Likhachev's Model into a Finite Element Program P. Terriault and V. Brailovski	160

Chapter 5: Mechanical Behavior, Shape Memory Effect, Pseudoelasticity and Other Functional Properties in Cu-Based Alloys

CuZr Based Shape Memory Alloys: Effect of Cr and Co on the Martensitic Transformation C.A. Biffi, A. Figini Albisetti and A. Tuissi	167
Characterization and Comparative Study of Pseudo-Elastic Cu-Zn-Al Foams Synthesized by Two Different Methods B.A. Weiss, P.A. Larochette, G. Bertolino, E.M. Castrodeza, A. Baruj and H.E. Troiani	172
Effect of Martensitic Transformation on the Optical Spectra of Cu-Mn-Al Alloy Y.V. Kudryavtsev, V.V. Kokorin, L.E. Kozlova, V.N. Iermolenko and S.M. Konoplyuk	177
Internal Friction during Reverse Martensitic Transformation in Mn-Cu Alloy with 45 % Mn G.V. Markova and E.S. Klyueva	183

Chapter 6: Mechanical Behavior, Shape Memory Effect, Pseudoelasticity and Other Functional Properties in Fe-Based and Other Alloys

Influence of Omega-Phase Precipitation Hardening on the Static and Dynamic Properties of Metastable Beta Ti-Nb-Zr and Ti-Nb-Ta Alloys V. Brailovski, S. Prokoshkin, K. Inaekyan and S. Dubinskiy	189
Unexpected Constrained Twin Hierarchy in Equiatomic Ru-Based High Temperature Shape Memory Alloy Martensite P. Vermaut, A. Manzoni, A. Denquin, F. Prima and R. Portier	195
Structural Mechanism of Reverse $\alpha \rightarrow \gamma$ Transformation and New Functional Properties of Fe-Ni Austenitic Alloys V.V. Sagaradze, I.G. Kabanova, N.V. Kataeva and M.F. Klyukina	200
Structural and Hardness Gradients in the Heat Affected Zone of Welded Low Carbon Martensitic Steels D.P. Dunne and W. Pang	206
Addressing Retained Austenite Stability in Advanced High Strength Steels E.V. Pereloma, A. Gazder and I.B. Timokhina	212
Influence of Mechanical Loading, Temperature and Chemical Composition on the Deformation Induced Martensite Formation in Metastable Austenitic Steels F. Hahnenberger, R. Skorupski, M. Smaga and D. Eifler	217
Study of Metallurgy and Mechanical Property on Japanese Sword M. Yaso, Y. Minagi, T. Takaiwa, K. Kubota, T. Kanaizumi, T. Ohba, S. Morito and T. Hayashi	222
The Microstructural Design and Control of Ultrahigh Strength-Ductility Martensitic Steels Based on a Novel Quenching-Partitioning-Tempering Process Y.H. Rong, K. Zhang, J.W. Dai and H.L. Yu	228
Influence of Mechanical Alloying on the Behavior of Fe-Mn-Si-Cr-Ni Shape Memory Alloys Made by Powder Metallurgy B. Pricop, U. Söyler, B. Özkal, N.M. Lohan, A.L. Paraschiv, M.G. Suru and L.G. Bujoreanu	237
Effect of Flux Constituents and Basicity Index on Mechanical Properties and Microstructural Evolution of Submerged Arc Welded High Strength Low Alloy Steel S. Jindal, R. Chhibber and N.P. Mehta	242
The Shape Memory Effect in Melt Spun Fe-15Mn-5Si-9Cr-5Ni Alloys A. Druker, P. La Roca, P. Vermaut, P. Ochim and J. Malarria	247
Shape Recovery in Stainless FeMnSiCrNi(-Co) SMA Processed by ECAE H.H. Bernardi, K.A. Käfer, L.K.F. Naito and J. Otubo	252
<i>In Situ</i> Optical Microscope Examinations of the $\varepsilon \leftrightarrow \gamma$ Transformations in FeMn(Cr) Austenitic Steels during Thermal Cycling M. Benke, V. Mertinger and F. Tranta	257
Effect of Cold-Rolling Rate on Texture in Ti-Mo-Al-Zr Shape Memory Alloy K. Hiramatsu, M. Tahara, T. Inamura, H. Hosoda and S. Miyazaki	262

Chapter 7: Mechanical Behavior, Shape Memory Effect, Pseudoelasticity and Other Functional Properties in TiNi-Based Alloys

Study of Nickel Segregation at the TiNi-Titanium Oxide Interface S.E. Kulkova, A.V. Bakulin, Q.M. Hu and R. Yang	269
Strain-Glass Revisited S. Kustov, D. Salas, E. Cesari, R. Santamarta, D. Mari and J. Van Humbeeck	274
Identification and Interpretation of Material Parameters of a Shape Memory Alloy (SMA) Model B. Piotrowski, Y. Chemisky, F. Meraghni, R. Echchorfi, N. Bourgeois and E. Patoor	276
Determination of the Characteristic Parameters of Tension-Compression Asymmetry of Shape Memory Alloys Using Full-Field Measurements Y. Chemisky, R. Echchorfi, F. Meraghni, N. Bourgeois and B. Piotrowski	281
Evolution of Temperature Profiles during Stress-Induced Transformation in NiTi Thin Films B. Krevet, V. Pinneker, M. Rhode, C. Bechthold, E. Quandt and M. Kohl	287
Peculiarities of Thermoelectric Force Behaviour in Nikelide Titane upon Non-Stationary Heating V.V. Rubanik, V.V. Rubanik Jr. and O.A. Petrova-Burkina	292

Features of Electroplastic Deformation and Electropulse Treatment for TiNi Alloys V.V. Stolyarov	297
Study of Surface State Influence on Functional Properties of Ti-Ni Alloys E.P. Ryklina	301
Effect of Annealing on the Transformation Behavior and Mechanical Properties of Two Nanostructured Ti-50.8at.%Ni Thin Wires Produced by Different Methods X.B. Wang, B. Amin Ahmadi, D. Schryvers, B. Verlinden and J. Van Humbeeck	306
Thermomechanical Fatigue Behavior of NiTi Wires A. Isalgué, J. Fernández, N. Cinca, I.G. Cano, R. Grau, C. Auguet and V. Torra	311
Influence of the Structure on the Strain-Controlled Fatigue of Nitinol M. Kollerov, E. Lukina, D. Gusev, P. Mason and P. Wagstaff	316
Structure, Phase Transformations and Properties of Rapidly Quenched Ti₂NiCu Alloys A.V. Pushin, A.A. Popov and V.G. Pushin	321
Functional Properties of TiNi Shape Memory Alloy after High Strain Rate Loading A.M. Bragov, A. Galieva, V. Grigorieva, A. Danilov, A.Y. Konstantinov, A.K. Lomunov, A. Motorin, E. Ostropiko and A. Razov	326
Pseudo Elastic Cyclic Deformation of Ti-Ni Alloy under Various Temperatures D.E. Kaputkin, T.V. Morozova and E.V. Esina	332
<i>In Situ</i> Structural Characterization of Laser Welded NiTi Shape Memory Alloys F.M. Braz Fernandes, K.K. Mahesh, C.M. Crăciunescu, J.P. Oliveira, N. Schell, R.M. Miranda, L. Quintino and J.L. Ocaña	338
Influence of Low Temperature Glow Discharge Nitriding and/or Oxiding Process on Structure and Shape Memory Effect in NiTi Alloy J. Lełątko, Z. Lekston, T. Wierzchoń and T. Goryczka	344
Shape Memory Effect in NiTiCo Strip Produced by Twin Roll Casting Technique T. Goryczka, P. Ochinnikov and J. Lełątko	348
Study of Two-Way Shape Memory Behavior of Amorphous-Crystalline TiNiCu Melt-Spun Ribbons A. Shelyakov, N. Sitnikov, S. Saakyan, A. Menushenkov, R. Rizakhanov and A. Korneev	352
NiTi Splat Features during Vacuum Thermal Spraying onto Several Substrates N. Cinca, A. Isalgué, J. Fernández and S. Sampath	357
Influence of Ultrasonic Treatment on Shape Memory Effects in Ti-50.4at.%Ni Alloy V.V. Rubanik, V.V. Rubanik Jr., V. Dorodeiko and S. Miliukina	362
TiNiCu Martensitic Transformation Characterization at Low Stress Levels through Thermomechanical Cycling A. Fabregat-Sanjuan, F. Ferrando, C. Urbina and S. de la Flor	367
Unusual Multistage Martensitic Transformation in TiNi Shape Memory Alloy after Thermal Cycling A. Sibirev, S. Belyaev and N. Resnina	372
Study of Martensitic Transformation in TiNi Intermetallic by the Methods of Low Frequency Internal Friction G.V. Markova, A.V. Shuytcev and A.V. Kasimtcev	377
Deformability and Shape Memory Properties in Ti₅₀Ni₅₀ Rolled with Electric Current A.A. Potapova and V.V. Stolyarov	383

Chapter 8: Magnetic Shape Memory Alloys

Recent Progress and Future Perspectives in Magnetic and Metamagnetic Shape-Memory Heusler Alloys A. Planes, L. Mañosa and M. Acet	391
3D Energy Analysis of Magnetic-Field Induced Martensite Reorientation in Magnetic Shape Memory Alloys Y.J. He, X. Chen and Z. Moumni	400
Effect of Magnetostatic Energy on the Magnetic Driving Forces and Field Induced Superelastic Behavior in Ni-Mn-Ga A.A. Likhachev	405
A Miniature Energy Harvesting Device Using Martensite Variant Reorientation M. Kohl, R.Z. Yin, V. Pinneker, Y. Ezer and A. Sozinov	411

Structural Changes in Co-Based F-SMA J. Kopeček, V. Kopecký, M. Landa and O. Heczko	416
Energy Dissipation of Martensite Reorientation in NiMnGa Single Crystals under Biaxial Compression X. Chen, Y.J. He and Z. Mounni	421
Modeling of Smart Material Properties of Heusler Alloys T. Breczko, V. Barkaline and Y. Douhaya	426
Microstructures of Fe-Pd Alloy Ribbons Subjected to Rapidly Solidified Melt Spinning Y. Kishi, T. Kubota, Z. Yajima, T. Okazaki, Y. Furuya and M. Wuttig	431
Microstructural Studies of NiCoMnIn Magnetic Shape Memory Ribbons K. Prusik, K. Baldys, D. Stróż, T. Goryczka and J. Lelątko	436
Magnetocaloric and other Properties of Cold Rolled Gd Ribbons S. Taskaev, V.D. Buchelnikov, A. Pellenen, D. Bataev, K. Skokov, V. Khovaylo and A. Aliev	441
Adiabatic Temperature Change in Metamagnetic Ni(Co)-Mn-Al Heusler Alloys V. Khovaylo, M. Lyange, K. Skokov, O. Gutfleisch, R. Chatterjee, X. Xu and R. Kainuma	446
Martensitic Transformation in Spark Plasma Sintered Compacts of Ni-Mn-Ga Powders Prepared by Spark Erosion Method in Cryogenic Liquids P. Ochín, A.V. Gilchuk, G.E. Monastyrsky, Y. Koval, A.A. Shcherba and S.N. Zaharchenko	451
Experimental Study of Magnetocaloric Effect in Ni-Fe-Mn-Ga and Ni-Co-Mn-Ga Heusler Alloys R. Fayzullin, V.D. Buchelnikov, S. Taskaev, M. Droboşyuk and V.V. Khovaylo	456
Theoretical Study of Magnetic Properties and Multiple Twin Boundary Motion in Heusler Ni-Mn-X Shape Memory Alloys Using First Principles and Monte Carlo Method K.I. Kostromitin, V.D. Buchelnikov, V.V. Sokolovskiy, A.P. Kamantsev, V. Koledov, V.G. Shavrov and P. Entel	461
Martensitic Transformation in Mn-Ni-Sn Alloys R. Coll, J. Bonastre, J. Saurina, J.J. Suñol, L. Escoda and B. Hernando	468
Ab Initio Study of Magnetic Properties and Phase Diagram of Ni-Mn-Ga Heusler Alloys M.A. Zagrebin, V.V. Sokolovskiy and V.D. Buchelnikov	473

Chapter 9: Martensitic Transformations in Nanostructured Alloys

Mechanocyclic and Time Stability of the Loading-Unloading Diagram Parameters of Nanostructured Ti-Nb-Ta and Ti-Nb-Zr SMA S. Prokoshkin, V. Brailovski, M. Petrzlik, M.R. Filonov and V. Sheremetyev	481
Microstructure and Mechanical Properties of the SPD-Processed TiNi Alloys D. Gunderov, A. Lukyanov, E. Prokofiev, A. Churakova, V.G. Pushin, S. Prokoshkin, V. Stolyarov and R. Valiev	486
Reversible Martensitic Transformation Produced by Severe Plastic Deformation of Metastable Austenitic Steel I. Litovchenko, A. Tyumentsev and A.V. Korznikov	491
Shape Memory Properties of Ultrafine-Grained Austenitic Stainless Steel K.A. Käfer, H.H. Bernardi, L.K.F. Naito, N.B. de Lima and J. Otubo	496
Structure and Properties of NiTi Shape Memory Alloys after Severe Plastic Deformation D. Stróż, J. Palka, Z. Lekston and G. Dercz	501
Martensitic Transformation in Ni-Al-Pt High Temperature Shape Memory Alloys G.E. Monastyrsky, P. Ochín, V.V. Odnosum, A.Y. Pasko, V.I. Kolomytsev and Y. Koval	506
Formation of Nanostructure Surface Layers from Materials with Shape Memory Effect TiNiCu in Conditions P.O. Rusinov and Z. Blednova	512
Structure and Properties of TiNi Alloy Subjected to Severe Plastic Deformation and Subsequent Annealing S. Belyaev, M. Drozdova, N. Frolova, V.P. Pilyugin, N. Resnina, V. Slesarenko and V. Zeldovich	518
Amorphization of Titanium Nickelide by means of Shear under Pressure and Crystallization at the Subsequent Heating N. Frolova, V. Zel'dovich, V.P. Pilyugin, V. Gundyrev and A. Patselov	525

Thermo- and Deformation Induced Martensitic Transformations in Binary TiNi-Based Alloys Subjected to Severe Plastic Deformation N.N. Kuranova, V.V. Makarov, V.G. Pushin and A.N. Uksusnikov	530
--	-----

Chapter 10: Mechanical Behavior, Shape Memory Effect, Pseudoelasticity and Other Functional Properties in Non-Metallic Materials

Crack Growth by the Isothermal Martensitic Phase Transformation in Tetragonal Zirconia Polycrystals K.H. Hwang and J.K. Lee	537
Influence of Sintering Process on the Mechanical Properties of Dental Zirconia Ceramics W.U. Park, J.M. Zhao, K.H. Hwang, T.S. Kim, C.H. Yu and J.K. Lee	542

Chapter 11: Medical Applications

Mechanical Behavior Study of NiTi Endodontic Files Taking into Account Anatomic Shape of Root Canals V. Legrand, S. Moyne, L. Pino, S.A. Chirani, S. Calloch, R. Arbab Chirani and V. Chevalier	549
Optimization of Superelastic Properties in Titanium-Niobium Alloys Using Short-Time Thermal Treatments F. Prima, F. Sun, W. El May, T. Gloriant, P. Laheurte, L. Jordan, P. Vermaut, R. Portier and Y.L. Hao	554
Role of Phase Stress in Variations of Cell Behavior on NiTi A. Danilov, V. Muhonen, J. Tuukkanen and T. Jämsä	559
Investigation of Electrochemical Behavior of Novel Superelastic Biomedical Alloys in Simulated Physiological Media Y.S. Zhukova, A.S. Konopatsky and Y. Pustov	566

Chapter 12: Technological Applications

Effect of Nitrogen Addition on Tempering and Strain Aging Processes of Thermomechanically Strengthened Structural Steels L.M. Kaputkina, V. Prokoshkina and G. Khadeev	573
TiPt HTSMA Produced by Spark Plasma Sintering of Elemental Powders S. Chikosha and H.K. Chikwanda	579
Prediction of Transformation Behavior of R-Phase SMA Actuators by the Application of Fuzzy Logic K. Lygin, P. Labenda and T. Sadek	584
Improvement of Actuating Properties of a SMA Coil Spring by Change in Coil Orientation K.K. Jee, J.H. Han and W.Y. Jang	589
Superficial Modifying by Materials with SME in Engineering Appendices Z. Blednova, P.O. Rusinov and M.A. Stepanenko	595
Structural-Mechanical Control of Bypass Reactivity in LISB for Space Application Using Alloys with Shape Memory Alloys N.A. Protsenko and Z. Blednova	601