

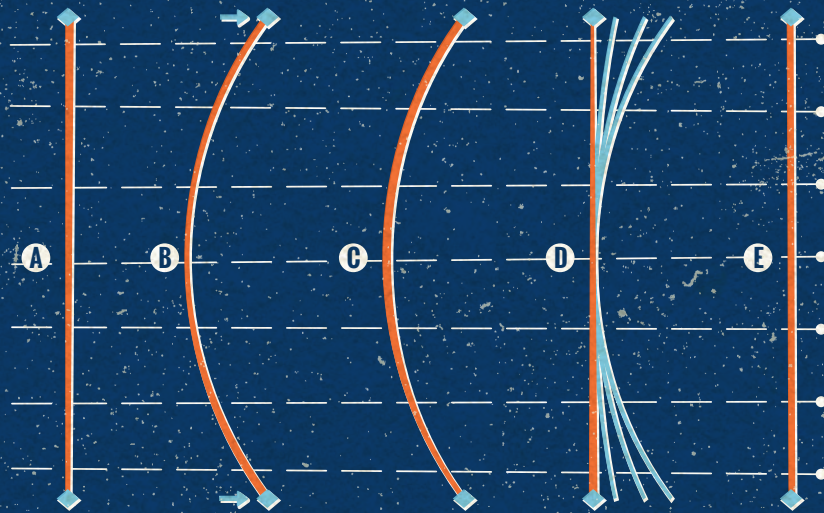


SMST 2015

THE MODEL FOR SHAPE MEMORY APPLICATION

SHAPE MEMORY AND SUPERELASTIC TECHNOLOGIES
CONFERENCE & EXPOSITION

FINAL PROGRAM



MAY 18-22, 2015

CROWNE PLAZA • HEYTHROP PARK RESORT • ENSTONE
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Since 1991, NDC has been serving the medical device industry with unparalleled knowledge and experience. From concept to commercialization, we strive to surpass your expectations at every stage of your product's lifecycle.

- 20-year proven track record of expertise in delivering high-quality and high-performing Nitinol devices
- Collaboration through the entire development and manufacturing process to maximize efficiency, decrease costs, and mitigate risk for our customers
- Deep understanding of the needs of endovascular, peripheral vascular, neurovascular, and cardiovascular customers
- Rapid development and prototyping capabilities to speed innovation and accelerate time to market

Share your ideas with us today—visit Nitinol.com or contact us at 510.683.2000.

SMST 2015 will focus on Nitinol, but this year will include sessions on other shape memory alloys and shape memory polymers. Technical sessions will explore fundamental issues still facing the industry, in the areas of fatigue, corrosion, and modeling and multiple sessions concerning industrial and medical applications.

For the first time, SMST 2015 will be held in centrally located Britain in an exclusive country manor within 440 acres of quintessential English parkland, Heythrop Park! I am honored to co-chair SMST 2015 with Dr. Keith Melton, a pioneer of Nitinol. I am looking forward to hearing Keith's co-authored plenary paper with Dr. Tom Duerig concerning the history of our industry.

Heythrop Park is close to University of Oxford so we have programmed free time during the conference to give you the opportunity to tour the Oxford College. Spring will be in full bloom, so bring an umbrella, just in case!

Dr. Neil Morgan, Co-Chair with Dr. Keith Melton of SMST 2015

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CONFERENCE REGISTRATION

Monday, May 18	1:00 p.m.–7:00 p.m.	Event Desk
Tuesday, May 19	7:30 a.m.–5:00 p.m.	Event Desk
Wednesday, May 20	7:30 a.m.–1:00 p.m.	Event Desk
Thursday, May 21	7:30 a.m.–4:00 p.m.	Event Desk

EXHIBITION

Monday, May 18	5:00 p.m.–8:00 p.m.	Ballroom and Foyer
Tuesday, May 19	4:00 p.m.–7:00 p.m.	Ballroom and Foyer

SOCIAL EVENTS

Please refer to the Social Events on page 10.

SESSION CHAIRS

REMINDER: Pick up your session packet at Registration the day of your session starting at 7:30 a.m. Within your packet, you will receive instructions and program information relevant to the day for you to pass along to your speakers. Twenty minutes prior to the start of your session, please meet your speakers in the meeting room you are assigned to review necessary conference information and to assist them in uploading their PowerPoint presentations.

SPEAKERS

REMINDER: All speakers must meet in the room of your presentation twenty minutes prior to the start of the session. This will allow all speakers the opportunity to meet their session chair, go over any final conference details and audio visual concerns and upload your PowerPoint presentation.

REFRESHMENT BREAKS

Daily refreshment breaks will be provided. Please refer to the Schedule of Events for exact timing and locations.

INTERNET

Wireless internet is available in the Heythrop Park Resort.

TRANSPORTATION TO TURF TAVERN-THURSDAY

Busses to Turf Tavern will be provided for the social event. Loading will begin at 5:45 p.m. in the Crowne Plaza Ballroom Car Park and busses will depart promptly at 6:00 p.m. Busses will be available to returning guests to the Heythrop Park Resort at 8:30 p.m., 9:15 p.m. and 9:30 p.m.

POLICY ON AUDIO AND VIDEO RECORDING OF TECHNICAL PAPER PRESENTATIONS/SESSIONS

SMST reserves the right to any audio and video reproduction of presentations at every technical session. Recording of sessions (audio, video, still photography, etc.) intended for personal use, distribution, publication or copyright without the express written consent of SMST and the individual is strictly prohibited.

POLICY ON CELLULAR PHONE USAGE

In consideration of fellow event attendees and presenters, show management kindly requests your cooperation in minimizing disturbances which may occur during technical sessions. We ask that cellular phones or other electronic devices be placed in “silent mode” while you are in the meeting rooms. Please step outside the meeting room if you need to have a conversation.

AMERICANS WITH DISABILITIES

In accordance with the Americans with Disabilities Act (ADA) of 1990, SMST is striving to accommodate all of our guests with special needs. If a disability requires that you have access to modified housing, transportation or other assistance,

please inform the conference staff

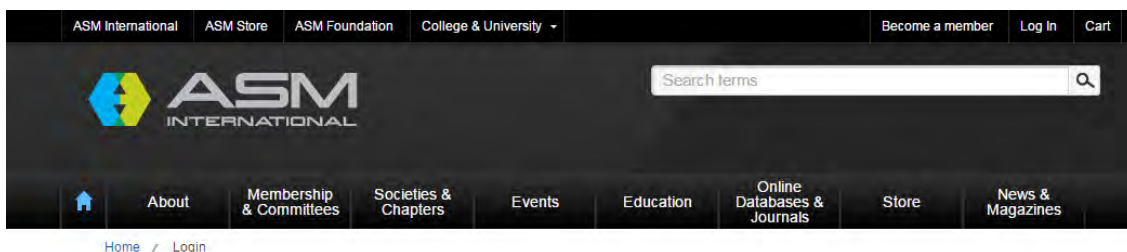
CONFERENCE PROCEEDINGS

Conference Proceedings are available to all registered attendees. To access and download the proceedings, log into ASM International's website and look up SMST 2015 within the Conference Proceedings webpage.

Download Instructions: SMST 2015 Conference Proceedings (Extended Abstracts)

We are honored to offer this Proceedings of the 2015 SMST Conference and Exposition to all attendees who receive the proceedings with their conference registration. The conference proceeding is made possible through the diligent work of all the individuals who created the extended abstracts, the technical chairs, and the proceeding editor. Below are the step-by-step instructions on how to access the 2015 Proceedings.

1. Go to **www.asminternational.org** AND log-in the site using your ASM ID and Password. You will receive this information through email. See registration if you need your ASM ID to login. Please note if you register within two weeks of the conference or on-site, access to the proceedings will be available 24–48 hours after the start of the conference.



Login

Please enter your email address/ID and password to log into the website. [Contact us](#) if you have any questions.

Required fields are marked with an asterisk *

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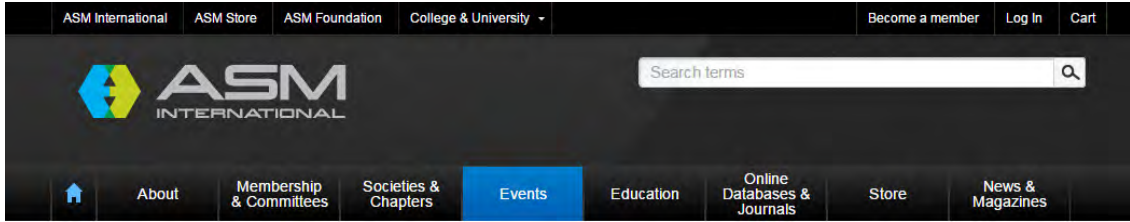
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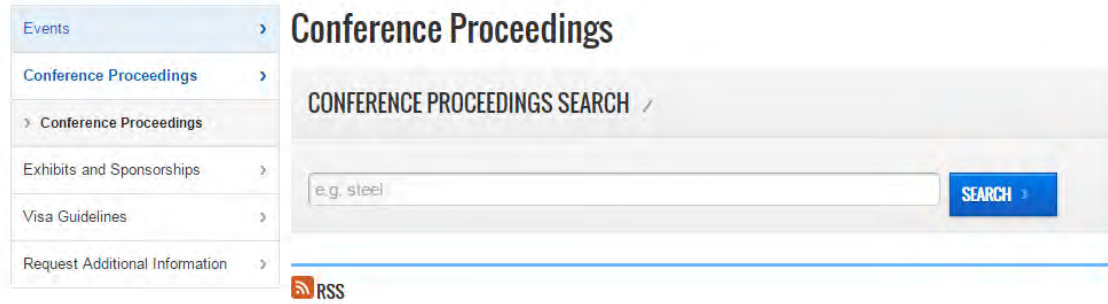
2. Click on the EVENTS tab at the top of the page



3. Click on CONFERENCE PROCEEDINGS on the left side navigation bar



4. Enter SMST 2015 in CONFERENCE PROCEEDINGS SEARCH field and click on SEARCH .



5. Click on the SMST 2015 search results to access the complete proceedings.

All Proceedings files are in Adobe PDF format. To view/print these files you will need to have a PDF reader installed, which comes standard with most personal computers. If you need to obtain a PDF reader, see the Adobe website at <http://get.adobe.com/reader/>, for information about downloading a free PDF reader.

SMA WORKSHOP

Monday, May 18, 2015
 Heythrop Park Resort
 Hanborough Room
 9:00 a.m.–5:00 p.m.

An optional all-day education course on Nitinol Technology will be held for those who wish to gain a more fundamental understanding of shape memory and superelasticity. Course topics will include:

How Nitinol works: Basic thermal and mechanical properties

How to make Nitinol: Processing to optimize in vivo performance of medical devices

How to design with Nitinol: Strategies on design of medical devices

How Nitinol performs: Insight into fatigue and corrosion properties

This course is an excellent opportunity for attendees to strengthen their understanding of shape memory and superelastic materials in advance of the technical sessions.

SMST WORKSHOP ORGANIZER

Dr. Alan R. Pelton
 Chief Technical Office
 G. RAU, Inc.

8:30	Registration
9:00	Welcome
9:05	Introduction to Shape Memory and Superelasticity
10:00	Coffee Brea
10:15	Processing
12:00	Lunch
13:00	Design and Analysis
14:15	Fatigue
15:30	Coffee Brea
15:45	Corrosion and Hydrogen Embrittlement
17:00	Adjourn

SMST FELLOWSHIP SPONSORS

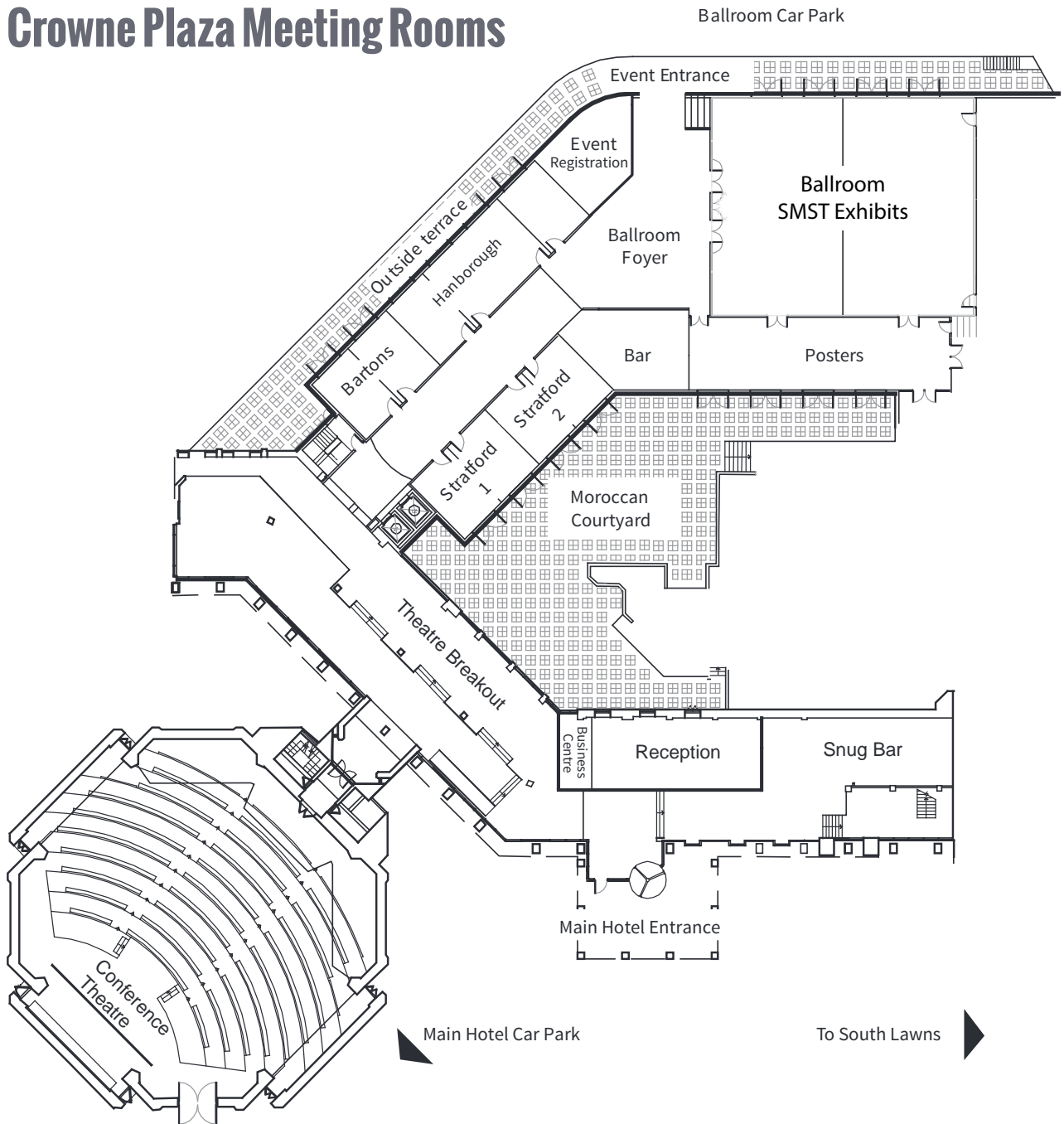
SMST gratefully acknowledges these generous sponsors of the first SMST Fellowship. The \$25,000 fellowship was awarded to Ahmadreza Jahad of the University of Toledo for his paper "Additive Manufacturing of Nitinol Fixation Hardware for Reconstructing Mandibular Segmental Defects."



FORT WAYNE METALS



Crowne Plaza Meeting Rooms



SCHEDULE OF EVENTS

Monday, May 18, 2015

Sessions	Time	Room
Nitinol Course	9:00 a.m. –5:00 p.m.	Hanborough
<i>Morning Refreshment Break: 10:00 a.m. • Meeting Space Foyer</i>		
<i>Lunch: 12:00 p.m.–1:00 p.m. • Brassery Restaurant</i>		
<i>Afternoon Refreshment Break: 3:00 p.m. • Meeting Space Foyer</i>		
<i>Welcome Reception/Exhibits: 5:00 p.m.–8:00 p.m. • Ballroom and Ballroom Foyer</i>		
End of Day		

Tuesday, May 19, 2015

Sessions	Time	Room
Plenary Presentation–History of Our Industry	8:30 a.m.–9:15 a.m.	Conference Theater
Medical Applications 1	9:15 a.m.–11:15 a.m.	Conference Theater
<i>Morning Refreshment Break: 10:15 a.m.–10:35 a.m. • Meeting Space Foyer</i>		
Fatigue 1	11:15 a.m.–3:35 p.m.	Conference Theater
<i>Lunch: 12:35 p.m.–1:55 p.m. • Brassery Restaurant</i>		
<i>Afternoon Refreshment Break: 2:35 p.m.–2:55 p.m. • Meeting Space Foyer</i>		
Production and Processing 1	2:55 p.m.–3:55 p.m.	Hanborough
Medical Applications 2	3:35 p.m.–4:15 p.m.	Conference Theater
<i>Exhibitor & Poster Reception: 4:00 p.m.–7:00 p.m. • Ballroom and Ballroom Foyer</i>		
End of Day		

Wednesday, May 20, 2015

Sessions	Time	Room
Plenary Presentations 1. Corrosion and Biological Response 2. Additive Manufacturing of Nitinol Fixation Hardware for Reconstructing Mandibular Segmental Defects	8:30 a.m.–9:15 a.m. 9:15 a.m.–9:40 a.m.	Conference Theater
<i>Morning Refreshment Break: 9:40 a.m.–10:00 a.m. • Meeting Space Foyer</i>		
Modelling and Characterization	10:00 a.m.–12:20 p.m.	Hanborough
Corrosion and Biological Response	10:00 a.m.–12:40 p.m.	Conference Theater
<i>Lunch: 12:30 p.m. 1:30 p.m. • Brassery Restaurant</i>		
Afternoon Open–Explore Oxford and London	1:30 p.m.	On Own
End of Day		

SCHEDULE OF EVENTS

Thursday, May 21, 2015

Sessions	Time	Room
Plenary Presentation–Engineering Nitinol Thin Films for Medical Devices – A Process Review	8:30 a.m.–9:15 a.m.	Conference Theater
Non-Medical Applications 1	9:15 a.m.–11:55 a.m.	Hanborough
Thin Film Applications	9:15 a.m.–12:15 p.m.	Conference Theater
<i>Morning Refreshment Break: 9:55 a.m.–10:35 a.m. • Meeting Space Foyer</i>		
Non-Medical Applications 2	11:55 a.m.–1:55 p.m.	Hanborough
<i>Lunch: 12:35 p.m.–1:35 p.m. • Brassery Restaurant</i>		
Production and Processing 2	1:35 p.m.–2:35 p.m.	Conference Theater
Ternary Alloys and Polymers	1:55 p.m.–2:55 p.m.	Hanborough
<i>Afternoon Refreshment Break: 2:35 p.m.–3:15 p.m. • Meeting Space Foyer</i>		
<i>Banquet Dinner: 6:30 p.m.– 9:30 p.m. • Turf Tavern • Sponsored By: Euroflex (Transportation Provided. Load busses at 5:45 p.m. at the Crowne Plaza Ballroom. Busses depart at 6:00 p.m.)</i>		
End of Day		

Friday, May 22, 2015

Sessions	Time	Room
Fatigue 2	8:30 a.m.–10:50 a.m.	Hanborough
<i>Morning Refreshment Break: 9:30 a.m.–9:50 a.m. • Meeting Space Foyer</i>		
Conference Concludes		

2015 SMST EVENT COMMITTEES

SMST 2015 CONFERENCE CO-CHAIRS:

Dr. Neil Morgan
Advaniti, Ltd.

Dr. Keith Melton
Consultant

STEERING COMMITTEE:

Dr. Tom Duerig
Nitinol Devices and Components

Dr. Michael R. Mitchell
Mechanics & Materials Consulting, LLC

Dr. Darel E. Hodgson, FASM
Nitinol Technology

Dr. Alan R. Pelton
G.Rau

Dr. Matthias Mertmann
Memry GmbH

WELCOME RECEPTION

Join us at your leisure on Monday, May 18th from 5:00 p.m.–8:00 p.m. for a chance to network and meet with your colleagues and the SMST exhibitors as people arrive and get settled at the Heythrop Park Resort. This year's welcome reception will be held in the Ballroom and Foyer. Casual attire please.

EXHIBITOR & POSTER RECEPTION

The exhibition will take place on Tuesday, May 19th from 4:00 p.m.–7:00 p.m. in the Ballroom and Foyer. Come for an evening of fun, food and friends; products and services from the enterprise community will be on display for SMST attendees.

WEDNESDAY AFTERNOON FREE TIME

The afternoon has been left for you to explore Oxford and surrounding areas, or if you would like, you can go into London and see a variety of local attractions.

THURSDAY EVENING SOCIAL EVENT

Sponsored By: **EUROFLEX**[®]
WE CREATE SOLUTIONS

This year's Social Event will be at the Turf Tavern in Oxford on Thursday, May 21st from 6:30 p.m.–9:30 p.m. Enjoy an evening with your colleagues at this local favorite with traditional British fare and drinks. Transportation from the Heythrop Park Resort will be provided.

Busses will depart promptly at 6:00 p.m. at the Heythrop Park Resort Lobby. Please arrive at the Crowne Plaza Ballroom Car Park by 5:45 p.m. Busses returning to the Heythrop Park Resort from Turf Tavern will depart at 8:30 p.m., 9:15 p.m. and 9:30 p.m.

Tuesday, May 19, 2015

Plenary–History of our Industry

8:30 a.m.–9:15 a.m.

Meeting Room: Conference Theater

Session Chair:

Dr. Neil Morgan
Avaniti, Ltd.
United Kingdom

8:30 a.m.

History of our Industry: Keith Melton¹, ¹Consultant, United Kingdom and **Dr. Tom Duerig²**, ² Nitinol Devices and Components, Fremont, CA

Abstract: Two of the technical and commercial frontiersmen of shape memory and superelasticity reunite to give a somewhat personal overview of the history of our industry and its evolution. Brown-Boveri was at the technical forefront in the 1970's but lacked the commercial focus needed to succeed. Raychem had the commercial focus, but its position on intellectual property made collaboration difficult, presenting enormous barriers to success. "Industrial Aspects", the precursor to this conference, was organized to break down these barriers and the ensuing progress was unstoppable.

This presentation tracks the overall changes, coloured by several personal anecdotes. The presentation will finish by highlighting a number of problematic gaps in our understanding of these alloys, highlighting that this is still an immature field still in need of fundamental research.

Medical Applications I
9:15 a.m.–11:15 a.m.
Meeting Room: Conference Theater

Session Chair:

Michael Healy
Lombard Medical
Oxfordshire, United Kingdom

9:15 a.m.

The Competition Between R and M Martensites in Nitinol Medical Devices: Dr. Tom Duerig, Nitinol Devices and Components, Fremont, CA

9:35 a.m.

Design of a Shape Memory Alloy Self-Expanding Stent via Open Source Optimization Methods: Mr. Thibaut Brosse¹ and **Dr. Darren J. Hartl²**, ¹Department of Mechanical Engineering, Ecole Nationale d'Ingénieurs de Saint Etienne, Saint-Etienne, France, ²Aerospace Vehicle Systems Institute, Texas A&M Engineering Experimentation Station, College Station, TX

9:55 a.m.

Influence of Storage Conditions on Clinically Relevant Properties of Peripheral NiTi Stents: Dr. Matthias Frotscher¹ and Mr. Martin Kiekbusch², ¹Stent Testing, CORTRONIK GmbH, Rostock-Warnemünde, Germany, ²Passive Devices Design, CORTRONIK GmbH, Rostock-Warnemünde, Germany

.....
10:15 a.m.–10:35 a.m.

• **Refreshment Break • Meeting Space Foyer** •
.....

10:35 a.m.

Failure Mode Analysis of Nitinol Medical Devices: Fractography of Stent Structures: Mr. Chris Bräuner¹, Dr. Markus Wohlschlägel², Dr. Andreas Schüßler² and Mr. Florian Weidner², ¹Admedes Schuessler, Pforzheim, Germany, ²ADMEDES Schuessler GmbH, Pforzheim, Germany

10:55 a.m.

Comparison of the Behaviour of Product Specific Parameters for a Nitinol Heart Valve Frame Produced with Two Different Kinds of Standard Shape Set Processing: Fluidized Bed vs. Liquid Salt Bath: Mr. Chris Bräuner¹, Dr. Andreas Schuessler² and Dr. Markus Wohlschlägel¹, ¹ADMEDES Schuessler GmbH, Pforzheim, Germany, ²ADMEDES SCHUESSLER GmbH, Pforzheim, Germany

Fatigue 1
11:15 a.m.–3:35 p.m.
Meeting Room: Conference Theater

Session Chair:
Dr. Keith Melton
Consultant
United Kingdom

11:15 a.m.
Effect of Prestrain on Nitinol Fatigue Life: Dr. Ali Shami and Mr. Kelly Pike, R&D, NDC, Fremont, CA

11:35 a.m.
A Direct Method for Predicting the High-Cycle Fatigue Regime in SMAs: Application to Nitinol Stents: Dr. Michael Peigney, Laboratoire Navier, Ecole des Ponts ParisTech, Marne-la-Vallee cedex 2, France

11:55 a.m.
Fatigue Crack Growth in Shape Memory Alloys: Prof. Huseyin Sehitoglu, Mechanical Science and Engineering, University of Illinois, Urbana, IL

12:15 p.m.
Impact of Hydrogen on the Fatigue Behavior of Nitinol Wire and Diamond Shape Samples: Dr. Markus Wohlschlägel¹, Florian Weidner¹, Dr. Alan Pelton² and Dr. Andreas Schüßler¹, ¹ADMEDES Schuessler GmbH, Pforzheim, Germany, ²G.RAU Inc., Fremont, CA

12:35 p.m.–1:55 p.m.
• Lunch • Brassery Restaurant •

1:55 p.m.
FEA Study of the Impact of the Shape Setting Strategy on the Fatigue Performance of Nitinol Vascular Implants: Dr. Michael Wind¹, **Mr. Philipp Hempel¹**, Dr. Markus Wohlschlägel¹ and Dr. Andreas Schuessler², ¹Admedes Schuessler GmbH, Pforzheim, Germany, ²ADMEDES SCHUESSLER GmbH, Pforzheim, Germany

2:15 p.m.
Corrosion Fatigue of Superelastic NiTi Wires Subjected to Various Thermomechanical Loadings: Dr. Jan Racek¹, Dr. Petr Šittner², Mr. Ludek Heller¹, Dr. Jan Pilch³ and Mr. Lukas Kaderavek¹, ¹Department of Functional Materials, Institute of Physics ASCR, Prague 8, Czech Republic, ²Department of Functional Materials, Institute of Physics, Academy of Sciences of the Czech Republic, Prague, Czech Republic, ³Institute of Physics ASCR, Prague, Czech Republic

2:35 p.m.
• Refreshment Break • Meeting Space Foyer •

2:55 p.m.
Prolongation of Fatigue Life of Nitrogen Ion Implanted TiNi Shape Memory Alloy Tape: Dr. Kohei Takeda¹, Prof. Ryosuke Matsui¹, Prof. Hisaaki Tobushi¹, Mr. Shinichi Homma² and Prof. Stanislaw Kucharski³, ¹Department of Mechanical Engineering, Aichi Institute of Technology, Toyota, Japan, ²NIPPON TREX Co.Ltd, Toyokawa, Japan, ³Institute of Fundamental Technological Research, Polish Academy of Sciences, Warsaw, Poland

3:15 p.m.
Influence of Prestrain and Thermomechanical Treatment of Next Generation Nitinol Materials in Rotary-Bending Fatigue: Dr. Jochen Ulmer¹, Gerhard Sedlmayr², Hans Nusskern² and Dr. Alan Pelton³, ¹Euroflex GmbH, Pforzheim, Germany, ²G. Rau GmbH & Co. KG, Pforzheim, Germany, ³G.RAU Inc., Fremont, CA

Production and Processing 1
2:55 p.m.–3:55 p.m.
Meeting Room: Hanborough

Session Chair:
Mr. Frank Sczerzenie
SAES Smart Materials
New Hartford, NY USA

2:55 p.m.
In-situ Neutron Diffraction Studies of Increasing Tension Prestrain Amplitudes of Superelastic Nitinol: Dr. Aaron Stebner, Colorado School of Mines, Golden, CO

3:15 p.m.
Carbon Inclusions in NiTi SMAs: A Computational Thermodynamics Study: Dr. Federico Gallino¹, Mr. Marco Urbano² and Dr. Alberto Coda², ¹SAES Getters S.p.A., Lainate, Italy, ²SAES Getters S.p.A, Lainate, Italy

3:35 p.m.
On the Strong Dependence of Transformation Temperatures on Alloy Composition in NiTi-Based Shape Memory Alloys: Dr. Jan Frenzel¹, Mr. André Wiczorek¹, Mr. Burkhard Maass¹, I. Opahle², R. Drautz² and Prof. Gunther Eggeler¹, ¹Institute of Materials, Ruhr-University Bochum, Bochum, Germany, ²International Centre for Advanced Materials Simulation (ICAMS), Ruhr-University Bochum, Bochum, Germany

4:00 p.m.–7:00 p.m.
• Exhibitor & Poster Reception • Ballroom and Ballroom Foyer •

Medical Applications 2
3:35 p.m.–4:15 p.m.
Meeting Room: Conference Theater

Session Chair:

Ian Connell
 Lake Regional Medical
 Galway, Ireland

3:35 p.m.

A New Portable Device for Acute Ankle Rehabilitation with SMA-Based Actuation: Dr. Simone Pittaccio¹, Mr. Lorenzo Garavaglia¹ and Dr. Francesca Passaretti², ¹CNR IENI Institute for Energetics and Interphases - Italian National Research Council, Lecco, Italy, ²CNR- IENI Unità di Lecco, Lecco, Italy

3:55 p.m.

Metallurgical Characterization and Three-Point Bend Testing of Rotary Nickel-Titanium Endodontic File: Dr. C Y Chung and Ray Chun Tung Wu, Department of Physics & Materials Science, City University of Hong Kong, Hong Kong, China

4:00 p.m.–7:00 p.m.

• Exhibitor & Poster Reception • Ballroom and Ballroom Foyer •

Exhibitor & Poster Reception

4:00 p.m.–7:00 p.m.
Meeting Room: Ballroom and Ballroom Foyer

Accurate Determination of the Chemical Composition of Nickel-Titanium Binary Alloys by NIST High Performance Inductively Coupled Plasma—Optical Emission Spectroscopy Method: Dr. Xinwei Wang and Dr. Karol Putyera, EAG - NY, Evans Analytical Group LLC., Liverpool, NY

Bifurcation and Chaos Characteristics of Shape Memory Alloy Thin Cylindrical Shell Subjected to the Impact from Axial Viscous Fluid: Prof. Jia Xu, Dr. Ying-Xiao Kong and Prof. Zhi-Wen Zhu, Mechanics, Tianjin University, Tianjin, China

Blue Oxide—Next Generation Surface Finish: Dr. Andreas Schuessler¹, Mr. Gerd Siekmeyer¹, Mr. Chris Bräuner², Mr. Michael Quellmalz¹, Dr. Giorgio Cattaneo³ and Werner Mailänder³, ¹ADMEDES SCHUESSLER GmbH, Pforzheim, Germany, ²ADMEDES Schuessler GmbH, Pforzheim, Germany, ³Acandis GmbH u. Ko. KG., Pforzheim, Germany

Characterization Studies of Ni₅₀Ti_{50-x}Zr_x Shape Memory Alloys Produced by Spark Plasma Sintering: Mr. Prasanna Kumar Iyengar and Prof. V Sampath, Department of Metallurgical and Materials Engineering, IIT Madras, Chennai, India

Characterization of NiTi Alloys by Instrumented Nanoindentation: Experiments and Simulations: Mr. Miroslav Frost¹, A. Kruisová¹, V. Sháněl¹, Dr. Petr Sedlák¹, P. Haušild², Mr. Meni Kabla³, Prof. Doron Shilo³ and Dr. Michal Landa¹, ¹Institute of Thermomechanics, Prague, Czech Republic, ²Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University, Prague, Czech Republic, ³Mechanical Engineering, Technion, Israel Institute of Technology, Haifa, Israel

Comparison of Recrystallization Kinetics and Grain Growth in Shape Memory Alloys: Ms. Marcelo Nava¹ and Prof. Emmanuel Pacheco Rocha Lima², ¹CELME, IFBA, BARREIRAS, Brazil, ²University of Brasília, Brasília, Brazil

Cyclic Behavior and Microstructure Evolution under Temperature Change of Cu-Al Based Shape Memory Ribbons: Dr. Semra Ergen¹, Mr. Fikret Yilmaz¹, Mr. Necati Basman², Prof. Ugur Kolemen¹ and Prof. Orhan Uzun³, ¹Physics, Gaziosmanpasa University, Tokat, Turkey, ²Electronic, Bulent Ecevit University, Zonguldak, Turkey, ³Bulent Ecevit University, Zonguldak, Turkey

Development Self-Locking Bolts Using Shape Memory Alloy: Mr. Francisco Fernando Roberto Pereira and Dr. Carlos José de Araújo, Mechanical Engineering, Universidade Federal de Campina Grande, Campina Grande, PB, Brazil

Effect of Ternary Addition on Cytotoxicity of Cu-Based Shape Memory Alloys: Mr. T Rajesh Kumar Dora¹, Prof. V Sampath¹, Ms. Mansi S² and Prof. Mukesh Doble², ¹Department of Metallurgical and Materials Engineering, IIT Madras, Chennai, India, ²Department of Biotechnology, IIT Madras, Chennai, India

Enhancing Mechanical and Shape Memory Properties in Hyper-Branched Epoxy Shape Memory Polymers: Dr. Silvia De la Flor¹, Mr. David Manuel Santiago¹, Mr. Albert Fabregat¹, Dr. Francesc Ferrando¹ and Dr. Xavier Fernández-Francos², ¹Department of Mechanical Engineering, Universitat Rovira i Virgili, Tarragona, Spain, ²Centre Tecnològic de la Química de Catalunya, Tarragona, Spain

Experimental Evaluation of the Emissivity of a NiTi Shape Memory Alloy: Mr. Tadeu Casto da Silva and Prof. Edson Paulo da Silva, Mechanical Engineering, University of Brasília, Brasília, Brazil

Influence of Time of Cryogenic Soaking in Thermal and Mechanical Properties of an NiTi Shape Memory Alloy: Mr. Bartholmeu Ferreira da Cruz Filho¹, Mr. Weimar Silva Castilho¹ and Prof. Edson Paulo da Silva², ¹Mechanical Engineering, University of Brasilia, Brasília, Brazil, ²Mechanical Engineering, University of Brasília, Brasília, Brazil

Investigation of Substrate Effect on Microstructure And Mechanical Behavior of NiTi-based Thin Films: Dr. Maryam Mohri¹, Prof. Mahmoud Nili-Ahmadabadi² and Prof. Horst Hahn¹, ¹Karlsruhe Institute of Technology (KIT), INT, Karlsruhe, Germany, ²School of Metallurgy and Materials Engineering, University of Tehran, Tehran, Iran

Modeling a Bearing with Changeable Stiffness Based on Shape Memory Alloys for Vibration Control of Rotating Machinery: Mr. Arthur Pinheiro Barcelos and Prof. Edson Paulo da Silva, Mechanical Engineering, University of Brasília, Brasília, Brazil

Nanoindentation Studies on Superelastic Behaviour of Cu-based Shape Memory Alloys Processed via Different routes: Mr. T Rajesh Kumar Dora¹, Mr. Prasanna Kumar Iyengar¹, Prof. V Sampath¹, Dr. Om Prakash Modi² and Mr. Muhamed Shafeeq M², ¹Department of Metallurgical and Materials Engineering, IIT Madras, Chennai, India, ²CSIR-Advanced Materials and Processes Research Institute, Bhopal, India

Partial Shape Memory Effect: A New Concept of Shape Memory Polymers: Dr. Sofiane Abdallah-Elhirszi¹, Prof. Abbas Tcharkhtchi¹, Dr. Joseph Fitoussi¹, Prof. Kambiz Ebrahimi², Dr. Mohammadali Shirinbayan¹ and Dr. Sedigheh Farzaneh¹, ¹Arts et Métiers ParisTech, PIMM, UMR 8006 CNRS, Paris, France, ²School of Engineering, University of Bradford, Bradford, England

Self-Heating of Superelastic NiTi Shape Memory Alloys for Fatigue Study of Endodontic Files: Mr. Vincent Legrand^{1,2}, Dr. Luc Saint-Sulpice², Dr. Laurent Pino², S. Arbab Chirani² and Prof. Sylvain Calloch¹, ¹LBMS Ensta-Bretagne, BREST, France, ²LBMS ENIB, Brest, France

Shape Memory Effect in Aging of Ni-Ti Shape Memory Alloy Wire Bent in V-Shape at Room Temperature: Prof. Kuang-Jau Fann and Pao-Min Huang, Department of Mechanical Engineering, National Chung Hsing University, Taichung, Taiwan

Thermo-Magneto-Mechanical Coupling Dynamic Behavior of Ferromagnetic Shape Memory Alloys: Mrs. Oana-Zenaida Pascan^{1,2}, Yongjun He¹, Mr. Ziad Moumni^{1,2} and Mr. Weihong Zhang², ¹UME-MS, ENSTA-Paristech, Palaiseau, France, ²Northwestern Polytechnical University, Xi'an, China

Thermomechanical Characterization of NiTiCu Shape Memory Alloy Under Tension, Compression And Torsion Loading Conditions: Mr. Albert Fabregat-Sanjuan, Dr. Francesc Ferrando and Dr. Silvia De la Flor, Department of Mechanical Engineering, Universitat Rovira i Virgili, Tarragona, Spain

Tracking Deformation Processes in Nitinol Using Fast Infrared Imaging: Mr. E. Alarcon^{1,2}, Dr. Luc Saint-Sulpice¹, S. Arbab Chirani³, Dr. Ludek Heller², Dr. Petr Sittner² and Prof. Sylvain Calloch⁴, ¹LBMS, ENSTA Bretagne, BREST cedex 9, France, ²Institute of Physics ASCR, Prague, Czech Republic, ³LBMS, ENSTA Bretagne, Brest, France, ⁴LBMS, Brest, France

Wednesday, May 20, 2015

Plenary - Corrosion and Biological Response

8:30 a.m.-9:15 a.m.

Meeting Room: Conference Theater

Session Chair:

Dr. Neil Morgan

Avaniti, Ltd.

United Kingdom

8:30 a.m.

Corrosion and Biological Response: Mrs. Christine Trepanier, NDC, Fremont, CA

Abstract: Corrosion of implantable medical devices can have deleterious effects on the device performance or may result in the release of corrosion products with harmful biological consequences. Therefore, it is critical to determine and optimize the corrosion behavior of medical devices during the development phase of medical devices. Moreover, the forming and finishing steps used to create an implantable device have significant effects on the corrosion resistance of the material. Several studies have shown the importance of passivation process to improve the corrosion resistance and biocompatibility of Nitinol devices. These processes dissolve the nickel-rich phase formed from thermally oxidized Nitinol and promote the formation of a uniform and protective titanium oxide layer that provides Nitinol with good corrosion resistance. The purpose of this presentation is to review studies performed to characterize the surface properties of Nitinol and the impact on the corrosion behavior of the material.

Special SMST Fellowship Presentation

9:15 a.m.-9:40 a.m.

Meeting Room: Conference Theater

Session Chair:

Neil Morgan

Avaniti, Ltd.

United Kingdom

9:15 a.m.

Additive Manufacturing of Nitinol Fixation Hardware for Reconstructing Mandibular Segmental Defects: Mr. Ahmadreza Jahad¹, M. Taheri Andani¹, N. Moghaddam¹, C. Haberland¹, D. Dean², J. Walker², Prof. H.E. Karaca³, R. Skoracki², M. Miller² and **Prof. Mohammad Elahinia¹**, ¹Dynamic and Smart Systems Laboratory, University of Toledo, Toledo, OH, ²Department of Plastic Surgery, The Ohio State University, Columbus, OH, ³Mechanical Engineering, University of Kentucky, Lexington, KY

Abstract: The primary goal of this proposal is to advance the scientific knowledge of Nitinol by investigating production of 3D shapes using selective laser sintering, an additive manufacturing technique. This funding as intended by SMST is to provide a stipend for Ahmadreza Jahadakabr Walker, who is a Mechanical Engineering graduate student at the University of Toledo. Ahmadreza's dissertation is on design, manufacturing, and evaluation of functional 3D Nitinol devices. Dr. Elahinia, the PI, has spent the last 14 years investigating various aspects of research and application of Nitinol. In this capacity he has managed more than \$5 million in research funding. He will assume administrative and financial responsibility of the grant. The group has full access to a range of facilities at the Nitinol Commercialization Accelerator for conducting the proposed research. It is expected that the results of this investigation will create a paradigm shift in Nitinol research. Functional Nitinol devices with shape memory and superelastic properties with versatile geometries are fundamental to open innovation frontiers in disciplines such as medical devices and aerospace actuators.

9:40 a.m.-10:00 a.m.

• Refreshment Break • Meeting Space Foyer •

Modelling and Characterization
10:00 a.m.-12:20 p.m.
Meeting Room: Hanborough

Session Chair:

Dr. Ming Wu
Edwards Lifesciences
Irvine, CA USA

10:00 a.m.
Surface Characterization of Electro-Polished Nitinol Devices by Auger Analysis: Ms. Siobhan Carroll, Boston Scientific – Structural Heart, Los Gatos, CA

10:20 a.m.
Testing Internal Friction and High-Frequency Response in Pseudoelastic Ni-Ti: Mr. Lorenzo Garavaglia, Dr. Simone Pittaccio and Mr. Carlo Ceriotti, CNR IENI Institute for Energetics and Interphases - Italian National Research Council, Lecco, Italy

10:40 a.m.
A Large Elastic Strain in Fe-Pd and Fe-Pt Shape Memory Alloys: Prof. Takashi Fukuda and Prof. Tomoyuki Kakeshita, Department of Materials Science and Engineering, Graduate School of Engineering, Osaka University, Suita, Osaka, Japan

11:00 a.m.
Benefits of an Energy-Based Material Model During Industrial Engineering of SMA: Dr. Philipp Junker and Prof. Klaus Hackl, Computational Engineering, Ruhr-Universität Bochum, Bochum, Germany

11:20 a.m.
In Situ Synchrotron X-ray Diffraction Measurement of Simple Bending of NiTi Shape Memory Alloy Wires: Mr. Baozhuo Zhang and Dr. Marcus L. Young, Materials Science and Engineering, University of North Texas, Denton, TX

11:40 a.m.
Static and Dynamic Mechanical Behavior of Martensitic NiTi Shape Memory Alloys: Ms. Ying Qiu¹, Dr. Marcus L. Young¹ and Dr. Xu Nie², ¹Materials Science and Engineering, University of North Texas, Denton, TX, ²Mechanical and Energy Engineering, University of North Texas, Denton, TX

12:00 p.m.
Sensitivity of Nitinol Fatigue Strain on Material Inputs in Finite Element Analysis: Mr. Payman Safari, Mr. Karthik Senthilnathan and Dr. Tom Duerig, Nitinol Devices and Components, Fremont, CA

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12:30 p.m.-1:30 p.m.

• Lunch • Brassery Restaurant •

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Afternoon Open to Explore Oxford and London
• On Own •

Corrosion and Biological Response
10:00 a.m.-12:40 p.m.
Meeting Room: Conference Theater

Session Chair:

Dr. Markus Wohlschlägel
ADMEDES Schuessler GmbH
Pforzheim, Germany

10:00 a.m.
Corrosion Behavior of Large Nitinol Stent Structures Produced from Various Tubing Qualities: Dr. Markus Wohlschlägel, Hannah Blaich and Dr. Andreas Schüßler, ADMEDES Schuessler GmbH, Pforzheim, Germany

10:20 a.m.
Electrochemical Characterization of Nitinol Stents after Fretting and Flow Testing: Dr. Elizabeth Trillo¹, Mrs. Erica Macha¹, Mr. James Dante¹ and Dr. Xingguo Cheng², ¹Materials Engineering Department, SouthWest Research Institute, San Antonio, TX, ²Microencapsulation and NanoMaterials, Southwest Research Institute, San Antonio, TX

10:40 a.m.

Corrosion and Mechanical Properties of Atomic Layer Deposited TiO₂ Coatings on NiTi Alloys: Dr. Jan Racek¹, **Dr. David Vokoun**¹ and Dr. CC Kei², ¹Department of Functional Materials, Institute of Physics ASCR, Prague 8, Czech Republic, ²Instrument Technology Research Center, National Applied Research Laboratories, Hsinchu, Taiwan

11:00 a.m.

In-Vitro and In-Vivo Investigation of Nitinol Corrosion Behavior for Pedicle Screw Constructs: **Ms. Elena Lukina**¹, Dmitry Gusev², Yulia Chernyshova², Alla Khon², Arkadiy Kazmin³, Sergey Kolesov³, Paul Wagstaff¹, Peter Mason¹, Gordon W Blunn⁴ and Mikhail Kollerov², ¹Kings-ton University London, Thames ditton, United Kingdom, ²MATI-Russian State Technological University, Moscow, Russia, ³Central Institute of Traumatology and Orthopaedic, Moscow, Russia, ⁴UCL, London, United Kingdom

11:20 a.m.

Effect of Silver Addition on Biocompatibility of NiTi and NiTiCu Shape Memory Alloys: **Mr. Prasanna Kumar Iyengar**¹, Prof. V Sampath¹, Ms. Mansi S² and Prof. Mukesh Doble², ¹Department of Metallurgical and Materials Engineering, IIT Madras, Chennai, India, ²Department of Biotechnology, IIT Madras, Chennai, India

11:40 a.m.

Sequence of Steps of Nitinol Pitting in Phosphate Buffered Saline Solution: **Dr. Xu Huang**¹ and Mr. Denis W. Norwich², ¹Memry Corporation, Bethel, CT, ²R&D, Memry Corporation, Bethel, CT

12:00 p.m.

Comparison of Biocompatibility Ion-Release Testing Methods for NiTi Medical Devices: **Dr. Matthias Frotscher**¹, Mr. Martin Kiebusch², Mr. Robert Voegelé¹, Mr. Matthias Rose¹ and Ms. Patricia Decker¹, ¹Stent Testing, CORTRONIK GmbH, Rostock-Warnemünde, Germany, ²Passive Devices Design, CORTRONIK GmbH, Rostock-Warnemünde, Germany

12:20 p.m.

SMA for Energy Constraint in an Absorbable Implant: **Dr. Jeremy E. Schaffe** and Mr. Adam J. Griebel, Research and Development, Fort Wayne Metals Research Products Corporation, Fort Wayne, IN

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12:30 p.m.-1:30 p.m.

• Lunch • Brassery Restaurant •

.....
Afternoon Open to Explore Oxford and London

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Thursday, May 21, 2015

Plenary - Thin Films in Medical Devices

8:30 a.m.-9:15 a.m.

Meeting Room: Conference Theater

Session Chair:

Dr. Neil Morgan
Advanti, Ltd.
United Kingdom

8:30 a.m.

Engineering Nitinol Thin Films for Medical Devices—A Process Review: Dr. Andreas Schuessler¹, Mr. Gerd Siek-meyer¹, Mr. Wolfgang Kannowade¹ and Mr. Rodrigo Lima de Miranda², ¹ADMEDES SCHUESSLER GmbH, Pforzheim, Ger-many, ²Acqunadas, Kiel, Germany

Abstract: Engineering with Nitinol materials using lasers and textile technology from semi-finished materials like sheets, tubes and wires are proven manufacturing processes in the engineering community. It is well known how to develop and apply various process technologies in the most efficient and reliable way. Recently, Nitinol Sputter Deposition Technology has been proposed as an innovative manufacturing process resulting in superior fatigue per-formances and consistent material characteristics up to 85 µm thickness. Developing new and cost effective micro components and devices from sputter deposition, however, requires dedicated and advanced design rules.

The authors will review a number of engineering (e.g. FEA) and advanced processes to use Nitinol Sputter Technology for micro actuators and medical devices. A number of enhanced micro joining and femto-laser technologies for vari-ous types of system building concepts and product applications will be presented. Functional, mechanical and fatigue data will be reviewed to proof the safety and reliability of added system building processes to further guide in develop-ing integrated Nitinol implant and medical devices. Finally, general design guidelines to engineer future Nitinol Thin Films into products such as BioMEMS devices and in the areas of neurostimulation, cardiac rhythm management, ophthalmology, cochlea implants and other applications will be shown.

Non-Medical Applications I

9:15 a.m.-11:55 a.m.

Meeting Room: Hanborough

Session Chairs:

Dr. Othmane Benafan
NASA Glenn Research Center
Cleveland, OH USA

Dr. Jeremy E. Schaffer
Fort Wayne Metals Research Products Corporation
Fort Wayne, IN USA

9:15 a.m.

Exo-Muscular Systems Based on SMA for Space Suits:

Mr. Marcelo Collado¹, Mr. Cayetano Rivera¹, Mrs. Naiara Escudero¹, Mr. Alvaro Villoslada², Dr. Fernando Martín² and Dr. Luis Moreno², ¹Arquimea Ingeniería, SL, Lega-nes, Spain, ²RoboticsLab, Carlos III University of Madrid, Leganés, Spain

9:35 a.m.

Analysis and Design of Shape Memory Alloy Morph-

ing Radiators: Mr. Christopher L. Bertagne¹, **Dr. Dar-ren J. Hartl**², Dr. John D. Whitcomb¹ and Mr. Rubik B. Sheth³, ¹Aerospace Engineering Department, Texas A&M

University, College Station, TX, ²Aerospace Vehicle Sys-tems Institute, Texas A&M Engineering Experimentation Station, College Station, TX, ³EC6 - Crew and Thermal Systems Division, NASA - Johnson Space Center, Hous-ton, TX

9:55 a.m.

Standardized SMA Test Methods for Aerospace Appli-

cations: Mr. James H Mabe¹, Dr. Alberto Coda², **Dr. Dar-ren J. Hartl**³, Dr. Othmane Benafan⁴, Mr. Royi Padan⁵, Mr. Brian Van Doren⁶ and Mr. John R Webster⁷, ¹Boe-ing Research and Technology, The Boeing Company, Seattle, WA, ²SAES Getters S.p.A, Lainate, Italy, ³Aero-space Vehicle Systems Institute, Texas A&M Engineer-ing Experimentation Station, College Station, TX, ⁴NASA Glenn Research Center, Cleveland, OH, ⁵Advanced Materials Dept., Rafael Advanced Defense Systems Ltd., Haifa, Israel, ⁶ATI Specialty Alloys and Components, Albany, OR, ⁷Strategic Research Centre, Rolls-Royce plc, Derby, United Kingdom

9:55 a.m.-10:35 a.m.

• Refreshment Break • Meeting Space Foyer •

10:35 a.m.

A Super-Elastic Torsion Rod For Small Wing Unfolding: Mr. Royi Padan¹, Mr. Elad Sinai² and Mr. Yaron Ben-shmuel², ¹Advanced Materials Dept., Rafael Advanced Defense Systems Ltd., Haifa, Israel, ²Rafael Advanced Defense Systems Ltd., Haifa, Israel

10:55 a.m.

High Rate Testing of NiTi Actuator Wire: Dr. Jeremy E. Schaffe and C. Lockwood, Research and Development, Fort Wayne Metals Research Products Corporation, Fort Wayne, IN

11:15 a.m.

Damping and Re-Centering Capabilities of Super-elastic NiTi Wires: Evaluation of an In-Scale Device for Structural Control: Dr. Hugo Soul¹ and Dr. Alejandro Yawny², ¹Conicet. División Física de Metales, Centro Atómico Bariloche (CNEA), S. C. de Bariloche, IA, Argentina, ²CNEA/ CONICET, División Física de Metales, Centro Atómico Bariloche (CNEA), S. C. de Bariloche, Argentina

11:35 a.m.

Structure and Properties of Large Diameter Hot Rolled NiTi Bars for Seismic Applications: Dr. Weimin Yin, Frank Sczerzenie, Matt Long, Clarence Belden, Dr. R. M. Manjeri and Rich Lafond, SAES Smart Materials, New Hartford, NY

Thin Film Applications
9:15 a.m.-12:15 p.m.
Meeting Room: Conference Theater

Session Chair:

Mr. Gerd Siekmeyer
ADMEDES SCHUESSLER GmbH
Pforzheim, Germany

9:15 a.m.

Advances in Thin Film TiNi Shape Memory Alloys: Dr. Richard Fu¹, Prof. Eckhard Quandt² and Dr. Akira Ishida³, ¹University of the West of Scotland, Paisley, United Kingdom, ²Inorganic Functional Materials, Institute for Material Science, Christian-Albrechts-Universität zu Kiel, Kiel, Germany, ³Hybrid Materials Unit, National Institute for Materials Science, Tsukuba, Japan

9:35 a.m.

Characterization of Sputtered Micropatterned TiNi-based Thin Film Actuators: Dr. Christoph Bechtold¹, Dr. Rodrigo Lima de Miranda^{1,2}, Dr. Christiane Zamponi^{1,2}, Mr. Christoph Chluba^{1,2} and Prof. Eckhard Quandt², ¹Acquandas GmbH, Kiel, Germany, ²Inorganic Functional Materials, Institute for Material Science, Christian-Albrechts-Universität zu Kiel, Kiel, Germany

9:55 a.m.-10:35 a.m.

• Refreshment Break • Meeting Space Foyer •

10:35 a.m.

Evaluation of TiNi Thin Film Heart Valves for Trans-catheter Valve Replacement: Mr. Klaas Loger¹, Dr. Rodrigo Lima de Miranda^{1,2}, Mr. Alexander Engel³, Prof. Georg Lutter³ and Prof. Eckhard Quandt¹, ¹Inorganic Functional Materials, Institute for Material Science, Christian-Albrechts-Universität zu Kiel, Kiel, Germany, ²Acquandas GmbH, Kiel, Germany, ³University Hospital of Schleswig-Holstein, Department of Cardiovascular Surgery, Christian-Albrechts-Universität zu Kiel, Kiel, Germany

10:55 a.m.

Investigation of Precipitate-Rich TiNi-based Thin Films for Elastocaloric Cooling Devices: Mr. Christoph Chluba¹, Dr. Rodrigo Lima de Miranda^{1,2}, Mr. Hinnerk Ossmer³, Prof. Manfred Kohl³ and Prof. Eckhard Quandt¹, ¹University of Kiel, Materials Science, Kiel, Germany, ²Acquandas GmbH, Kiel, Germany, ³Karlsruhe Institute of Technology (KIT), IMT, Karlsruhe, Germany

11:15 a.m.

Nitinol Micro Actuators from Sputter Deposition for Local Drug Delivery: Mr. Gerd Siekmeyer¹, Mr. Wolfgang Kannowade¹, Dr. Andreas Schuessler¹, Dr. Rodrigo Lima de Miranda^{2,3} and Prof. Eckhard Quandt², ¹ADMEDES SCHUESSLER GmbH, Pforzheim, Germany, ²Institute for Materials Science, Inorganic Functional Materials, Christian-Albrechts-Universität zu Kiel, Kiel, Germany, ³Acquandas GmbH, Kiel, Germany

11:35 a.m.

NiTi Thin Film Technology for Endovascular Applications: Dr. Rodrigo Lima de Miranda^{1,2}, Dr. Giorgio Cattaneo³, Prof. Eckhard Quandt⁴, Mr. Gerd Siekmeyer⁵ and Dr. Andreas Schuessler⁵, ¹Acquandas GmbH, Kiel, Germany, ²Inorganic Functional Materials, Institute for Material Science, Christian-Albrechts-Universität zu Kiel, Kiel, Germany, ³Acandis GmbH u. Ko. KG., Pforzheim, Germany, ⁴Institute for Materials Science, Inorganic Functional Materials, Christian-Albrechts-Universität zu Kiel, Kiel, Germany, ⁵ADMEDES SCHUESSLER GmbH, Pforzheim, Germany

11:55 a.m.

Investigation of Microstructural Changes in Sputtered NiTi Thin Films Under Fatigue: Dr. Christiane Zamponi^{1,2}, Mr. Christoph Chluba^{1,2}, **Dr. Christoph Bechtold²**, Dr. Rodrigo Lima de Miranda^{1,2} and Prof. Eckhard Quandt¹, ¹Institute for Materials Science, Inorganic Functional Materials, Christian-Albrechts-Universität zu Kiel, Kiel, Germany, ²Acquandas GmbH, Kiel, Germany

12:35 p.m.-1:35 p.m.

• Lunch • Brassery Restaurant •

Non-Medical Applications 2

11:55 a.m.-1:55 p.m.

Meeting Room: Hanborough

Session Chair:

Dr. Giorgio Vergani
SAES Smart Materials
New Hartford, NY USA

11:55 a.m.

Nanocrystalline NiTi Shape Memory Thin Wires for Micro Actuators: Dr. Alberto Coda, Mr. Andrea Cadelli, Mr. Luca Fumagalli and Mr. Francesco Butera, SAES Getters S.p.A, Lainate, Italy

12:15 p.m.

Elastocaloric Cooling Device: Materials and Modeling: Dr. Jaka Tusek¹, Dr. Kurt Engelbrecht¹, Dr. Nini Pryds¹ and Dr. Lars P. Mikkelsen², ¹Department of Energy Conversion and Storage, Technical University of Denmark, Roskilde, Denmark, ²Department of Wind Energy, Technical University of Denmark, Roskilde, Denmark

12:35 p.m.-1:35 p.m.

• Lunch • Brassery Restaurant •

1:35 p.m.

Caloric Effects in Shape Memory Alloys—Optimizing NiTi for Solid State Refrigeration: Mr. André Wiczorek, Dr. Jan Frenzel and Prof. Gunther Eggeler, Institute of Materials, Ruhr-University Bochum, Bochum, Germany

Production and Processing 2

1:35 p.m.-2:35 p.m.

Meeting Room: Conference Theater

Session Chair:

Dr. Tom Duerig
Nitinol Devices and Components
Fremont, CA USA

1:35 p.m.

The Effects of Heat Treatment on the Properties of Shape Memory Nitinol Wires: Mrs. Luciana Prass Rolsen¹, Mr. David Plumley², Mr. Wayne Buchan¹ and Dr. Jeremy E. Schaffe³, ¹Nitinol, Fort Wayne Metals Research Products Corp., Fort Wayne, IN, ²Sales, Fort Wayne Metals, Fort Wayne, IN, ³Research and Development, Fort Wayne Metals Research Products Corporation, Fort Wayne, IN

1:55 p.m.

The Effect of Alloy Formulation, Cold Work and Inclusion Content on Micro-Void Formation in NiTi Alloy Fine Wires: Mr. Frank Sczerzenie¹, Dr. R. M. Manjeri¹, Clarence Belden¹, Rich Lafond¹ and Mr. Grant Brewer², ¹SAES Smart Materials, New Hartford, NY, ²SAES Memry, Bethel, CT

2:15 p.m.

Effects of Room Temperature Aging on Hydrogen-Charged Nitinol: Mr. Daniel Madamba and Dr. Tom Duerig, Nitinol Devices and Components, Fremont, CA

Ternary Alloys and Polymers

1:55 p.m.-2:55 p.m.

Meeting Room: Hanborough

Session Chair:

Dr. Petr Sittner
Institute of Physics ASCR
Prague, Czech Republic

1:55 p.m.

Materials Characterisation of NiTi and CuAlMn Shape Memory Alloy Bars Under Dynamic Bending: Mr. Haoyu Huang, Ms. Wenjun Xie and Dr. Wen-Shao Chang, University of Bath, Bath, United Kingdom

2:15 p.m.

Neutron Diffraction of Co-Ni-Ga High-Temperature Shape-Memory Single Crystals: Mr. Peter M. Kadletz¹, Mr. Philipp Krooss², Dr. Christoph Somsen³, Dr. Thomas Niendorf², Dr. Yuri I. Chumlyakov⁴, Prof. Wolfgang W. Schmahl¹ and Prof. Hans J. Maier⁵, ¹Section of Applied Crystallography, Ludwig-Maximilians-Universität, Munich, Germany, ²Institut für Werkstofftechnik TU Bergakademie Freiberg, Freiberg, Germany, ³Dept. of Materials Science, Ruhr University of Bochum, Bochum, Germany, ⁴Siberian Physical Technical Institute, Tomsk State University, Tomsk, Russia, ⁵Institute of Materials Science, Leibniz University of Hannover, Garbsen, Germany

2:35 p.m.

Transformation and Deformation Characterization of NiTiHf And NiTiAu High Temperature Shape Memory Alloys: **Mr. Lee Casalena**¹, Dr. Fan Yang¹, Dr. Daniel R Coughlin², Mr. Xiang Chen¹, Mr. Harshad Paranjape¹, Mr. Yipeng Gao¹, Dr. Matthew L Bowers¹, Dr. Ronald D Noebe³, Mr. Glen S Bigelow³, Mr. Darrell J Gaydos³, Dr. Santo A Padula³, Prof. Peter M Anderson¹, Prof. Yunzhi Wang¹ and Prof. Michael J Mills¹, ¹Department of Materials Science and Engineering, The Ohio State University, Columbus, OH, ²Los Alamos National Laboratory, Los Alamos, NM, ³NASA Glenn Research Center, Cleveland, OH

2:35 p.m.-3:15 p.m.

• Refreshment Break • Meeting Space Foyer •

Friday, May 22, 2015

Fatigue 2

8:30 a.m.-10:50 a.m.

Meeting Room: Conference Theater

Session Chair:

Dr. Alan R. Pelton

G.RAU Inc.

Fremont, CA USA

8:30 a.m.

The Effect of Maximum Incremental Forming Strain on the Fatigue Properties of Nitinol Wire: Mr. Dennis W. Norwich¹, **Mr. Michael Ehrlenspiel**², Mr. D. Mandanici², Ms. K. Duran² and Mr. X. Huang², ¹R&D, Memry Corporation, Bethel, CT, ²Memry Corporation, Bethel, CT

8:50 a.m.

Microstructure Evolution and Superelastic Fatigue of NiTi: **Dr. Petr Sittner**¹, Dr. Jan Pilch¹, Mr. Pavel Sedmak^{1,2,3}, Mr. Ondrej Tyc³ and Dr. Ludek Heller¹, ¹Institute of Physics ASCR, Prague, Czech Republic, ²ESRF, Grenoble, France, ³Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University, Prague, Czech Republic

9:10 a.m.

High Compressive Prestrain Reduces the Bending Fatigue Life of Nitinol Wire: **Dr. Alan R. Pelton**¹, Dr. Shikha Gupta², Dr. Jason Weaver², Dr. Xiao-Yan Gong³ and Dr. Srinidhi Nagaraja², ¹G.RAU Inc., Fremont, CA, ²Food and Drug Administration, Silver Spring, MD, ³Medical Implant Mechanics LLC, Aliso Viejo, CA

9:30 a.m.-9:50 a.m.

• Refreshment Break • Meeting Space Foyer •

10:10 a.m.

Fatigue Properties of Metastable Beta Ti-22Nb-6Zr (at%) Alloy for Load-Bearing Biomedical Applications: **Mr. Vadim Sheremetyev**¹, Prof. Vladimir Brailovski², Prof. Sergey Prokoshkin¹, Dr. Karine Inaekyan² and Dr. Sergey Dubinskiy¹, ¹Department of Plastic Deformation of Special Alloys, National University of Science and Technology, Moscow, Russia, ²Mechanical Engineering, Ecole de technologie superieure, Montreal, QC, Canada

10:10 a.m.

The Effect of Crimp Strain on the Fatigue Performance of Nitinol: **Dr. Paul Briant**¹, Dr. Brad James¹, Dr. Jeremy E. Schaffe², Mr. Lawrence E. Kay³ and Dr. Sarah Easley¹, ¹Exponent, Inc., Menlo Park, CA, ²Research and Development, Fort Wayne Metals Research Products Corporation, Fort Wayne, IN, ³Fort Wayne Metals Research Products Corporation, Fort Wayne, IN

10:30 a.m.

Improvements to the Fatigue Life of Shape Memory Alloys using Partial Transformation Cycles Based on Energy Output per Cycle: **Mr. F. Sluis**, Dr. H.E.N. Bersee, Dr. R.C. Alderliesten and Prof. R. Benedictus, Structural Integrity & Composites, Delft University of Technology, Delft, Netherland

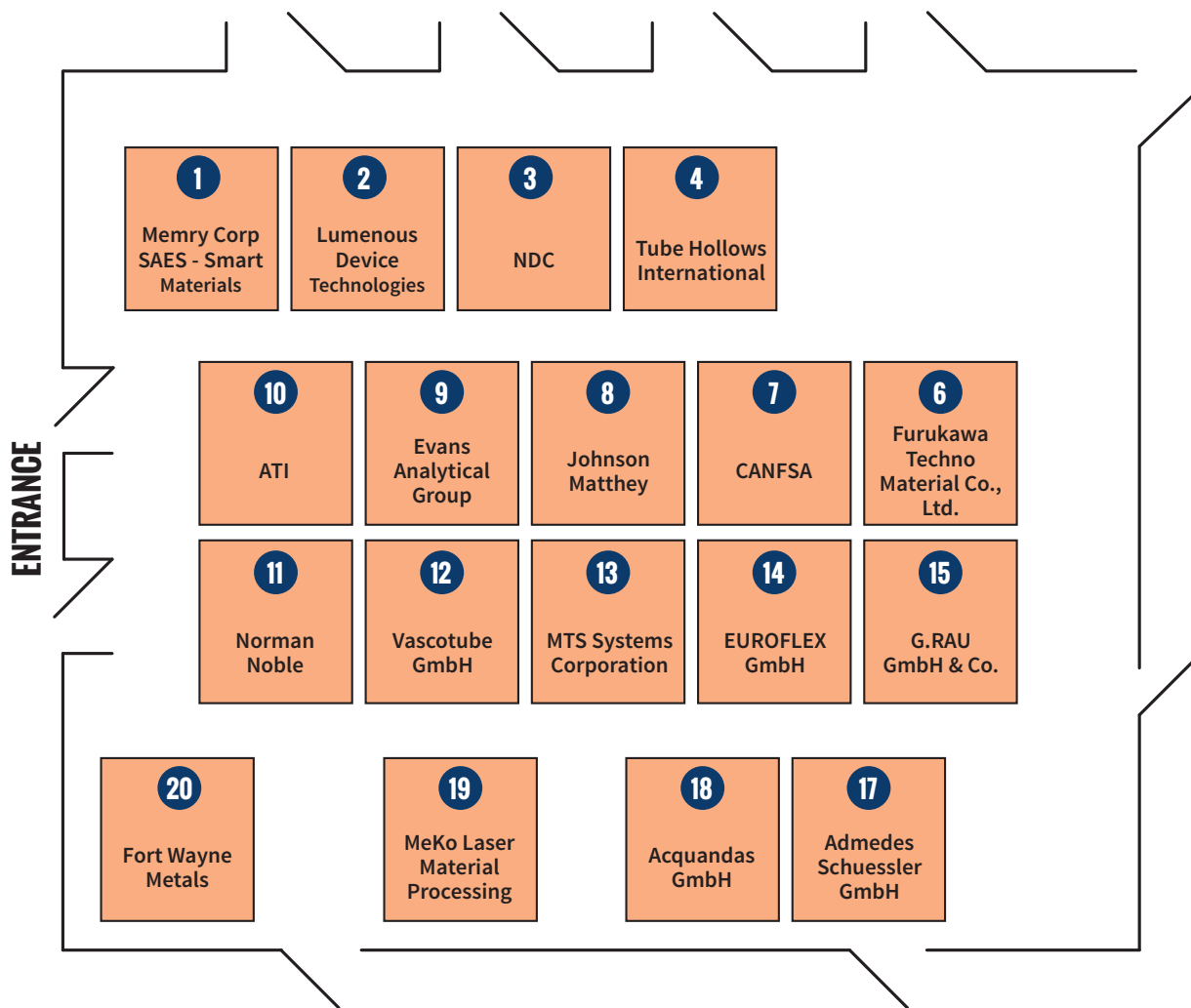
Exhibitor Hours

Welcome Reception / Exhibits
 Monday, May 18
 5:00 p.m.–8:00 p.m.

Exhibitor & Poster Reception

Tuesday, May 19
 4:00 p.m.–7:00 p.m.

**Times are tentative and subject to change.*



Exhibitor	Booth No.
Acquandas GmbH	18
Admedes Schuessler GmbH	17
ATI	10
Center for Advanced Non-Ferrous Structural Alloys (CANFSA)	7
EUROFLEX GmbH	14
Evans Analytical Group	9
Fort Wayne Metals	20
Furukawa Techno Material Co., Ltd.	6
G.RAU GmbH & Co.	15

Exhibitor	Booth No.
Johnson Matthey	8
Luminous Device Technologies	2
MeKo Laser Material Processing	19
Memry Corp SAES–Smart Materials	1
MTS Systems Corporation	13
NDC	3
Norman Noble	11
Tube Hollows International	4
Vascotube GmbH	12





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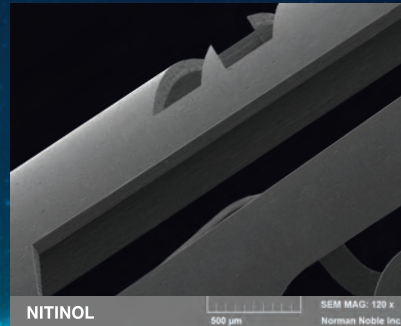
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Acquandas GmbH

Booth 18

Acquandas enables the development and fabrication of new generations of device components, implants, and actuators from Nitinol and other materials. By making use of our expertise in thin film deposition and structuring, we are able to manufacture components with unique properties and functionality, and a variety of design opportunities.
www.acquandas.com

Admedes Schuessler GmbH

Booth 17

ADMEDES is the leading global provider of finished Nitinol self-expandable implants. We apply the latest micro-machining and surface finishing techniques for rapid response prototypes, pilot line and full scale manufacturing. Together with products manufactured from tube, using advanced laser technology, we also developed a comprehensive range of wire forming technologies.
www.admedes.com

ATI

Booth 10

ATI is one of the largest and most diversified specialty materials and components producers in the world and uses innovative technologies to offer global markets a wide range of specialty materials solutions. We serve multiple markets with a range of low-carbon, shape memory and superelastic, nickel-titanium alloys.
www.ATImetals.com

The Center for Advanced Non-Ferrous Structural Alloys (CANFSA)

Booth 7

The Center for Advanced Non-Ferrous Structural Alloys (CANFSA) is an Industry-University Cooperative Research Center that leverages state-of-the-art research techniques at Colorado School of Mines, University of North Texas, and Iowa State University. Projects (currently 17) are performed in collaboration with our Industrial Advisory Board (currently 14 member institutions).
<https://canfsa.unt.edu>

EUROFLEX GmbH

Booth 14

EUROFLEX is a globally leading supplier of high-grade semi-finished products, components and actuators from a variety of materials for medical and industrial applications: Nitinol, CoCr, Stainless Steel, Ni-free Alloys, Titanium, Tantalum, Precious Metals, bioabsorbable Alloys, Platinum Alloys, Material Compounds.
www.euroflex.de

Evans Analytical Group

Booth 9

Evans Analytical Group (EAG) is the leading provider of materials characterization services to the implantable medical device industry. Services available include: Auger, XPS, TOF-SIMS, SEM, FTIR, Raman and further in-depth consultative services. EAG provides reliable, rapid, high-quality solutions from multiple global locations, including labs in the USA, Europe and Asia.
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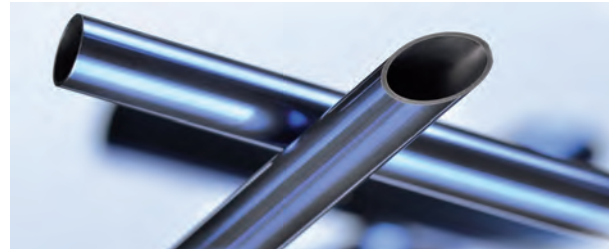
High-quality semi-finished products, components & actuators for the medical industry

Companies in the field of medical technology have diverse requirements when it comes to the materials used in their products. EUROFLEX offers a wide range of materials that are known for their innovation and quality.

EUROFLEX is a leading global supplier of high-grade semi-finished products, components and actuators from a variety of materials for medical and industrial applications.

Preferred in the field of medical technology, our semi-finished products are the foundation for implants such as vascular stents and filters, and a wide variety of other flexible medical instruments.

Partnering with you, we develop the next generation creative solutions using innovative materials.



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STAINLESS STEEL, NI-FREE ALLOYS
COBALT-BASED ALLOYS
TITAN-BASED ALLOYS
TANTALUM
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PLATINUM ALLOYS
BIOABSORBABLE ALLOYS
MATERIAL COMPOUNDS ...



ELEMENTS OF SHAPE MEMORY ALLOYS

Products can be made to customer specifications such as compression springs, extension springs, bending strips and free-form bending parts out of wire.

Preferred materials are different grades of nickel-titanium alloys. Further information about possible uses of these materials in medical technology is available on



www.euroflex.de

Vasco[®]tube

Finest Tubes for Medical Devices



www.vascotube.com

Fort Wayne Metals

Booth 20

Fort Wayne Metals is the world's only Nitinol melt source that is geared towards medical device and demanding industrial applications. We produce round wire as small as 0.013 mm, flat and shaped wire, centerless ground bar, strands, cables, composites and mechanical assemblies. ISO 9001, AS9100 and ISO 13485 certified.
www.fwmetals.com

Furukawa Techno Material Co., Ltd.

Booth 6

Furukawa has been manufacturing Nitinol for 50 years+. This experience and expertise enables us to offer highest quality material to the Medical device industry featuring long fatigue life. We manufacture from ingot stage through to final tubes and wires. Furukawa manufactures seamless NiTi tubes in a wide dimensional range.
<https://www.furukawa-ftm.com/english/index.ht>

G.RAU GmbH & Co.

Booth 15

G.RAU is a globally active supplier in the field of metal engineering that has achieved a degree of specialization in the highly complex and versatile world of metals over the past 140 years. G.RAU is an expert in manufacturing strips, tubes and wires made of precious metals, special alloys and composite materials.
www.g-rau.de

Johnson Matthey

Booth 8

Johnson Matthey is a premier producer of Nitinol tube, sheet, wire and shape set components for medical and industrial markets covering a wide variety of size and temperature ranges. In addition, offering the broadest range of capabilities in the fabrication of precious metals, we act as your single source for medical device components.
www.jmmedical.com

Lumenous Device Technologies

Booth 2

Lumenous, The Nitinol Device Experts™. Relentlessly focused on the best device performance, Lumenous develops processes for every purpose in Laser Cutting, Microwelding, Shapsetting, Electropolishing, Nitinol Wire and Tubing, Precision Assembly, and Design Engineering Services. Lumenous announces the TruePhase™ non-contact Af test system for ease-of-use, improved repeatability, and simultaneous component testing.
www.lumenous.com

MeKo Laser Material Processing

Booth 19

MeKo is a global ISO-certified supplier specialising in laser material processing for medical technology. The company boasts more than 20 years of experience, in particular in the area of laser cutting of stents, heart valve frames and other medical products made of metal and bioresorbable materials.
www.meko.de

Memry Corp SAES

Booth 1

Memry is a global leader in the invention and development of nitinol alloys and other superelastic and shape memory alloys, and the manufacture of nitinol semi-finished forms and fabricated components. With "melt to market" capabilities under one company roof, we provide customers in the medical device industry the opportunity to partner with us on one or all aspects of their component design.
www.memry.com

MTS Systems Corporation

Booth 13

Engineers and researchers worldwide rely on MTS for the testing expertise, innovative technology and responsive support required to pursue research and development of lighter, stronger, higher-performing materials. Understanding the fatigue life of alloys, such as nitinol, helps these engineers and researchers design better products and solutions.
www.mts.com

NDC

Booth 3

NDC is the leading contract manufacturer of Nitinol-based medical devices. With co-located manufacturing facilities in Fremont, CA and San Jose, Costa Rica, NDC has a proven, 20-year track record of partnering with the medical device community and delivering high-quality Nitinol devices and components in the endovascular, peripheral vascular, cardiovascular and neurovascular spaces.
www.nitinol.com

Norman Noble Incorporated

Booth 11

Norman Noble Inc. manufactures medical implants and devices to customer specifications in compliance with FDA regulations and ISO 13485:2012. Capabilities include seven-axis contour milling, Swiss turning, laser cutting and welding, EDM and Nitinol machining and shape setting. Prototype services are also available. Visit the company's Web site for more information.
www.nnoble.com

Tube Hollows International

Booth 4

Tube Hollows International specializes in delivering unique, engineered solutions to challenging design problems. Our ability to manufacture uniform-wall, seamless precision tubing at extreme depth-to-ID ratios, with industry-leading concentricity specs, has made us the world leader in custom heavy-wall tubing, hollow bars, precision cannulae and starting hollows. We specialize in machining nitinol, L605, 17-4PH and 17-7PH and other medical industry alloys.
www.tubehollows.com

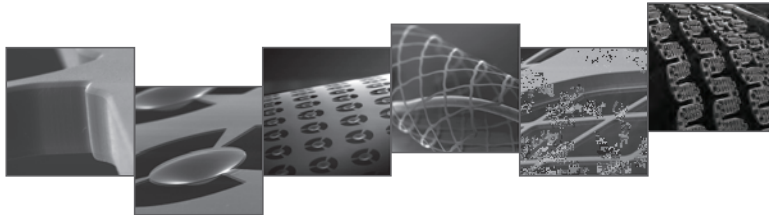
Vascotube

Booth 12

Vascotube GmbH serves the medical industry and has concentrated on tubing for implantable medical devices. The company is a leading manufacturer of nitinol, tantalum, and cobalt-based tubing. OD ranges from 0.17mm to 26mm.
vascotube.com

ACQUANDAS®

thin film solutions



Acquandas uses its expertise and know-how in thin film deposition, lithography, and chemical etching to manufacture device components from Nitinol and other materials, that exhibit unique properties and functionality.

Key benefits of our technology are:

- ▲ Miniaturization
- ▲ Complex Design Options
- ▲ Excellent Biocompatibility
- ▲ Micro-patterned Surfaces
- ▲ Rapid Prototyping
- ▲ Superior Mechanical Properties
- ▲ Multi-layered Implants
- ▲ Increased X-ray Visibility
- ▲ Easy Tuning of Composition
- ▲ Cost Efficient Production

In addition, we are able to

- ▲ provide the entire process development towards a fully functional thin film product
- ▲ rapidly fabricate prototypes in order to significantly reduce the time to market for your products
- ▲ fabricate your products with high scalability and reproducibility

Acquandas is your development partner for creating new products by exploiting the benefits of microsystem technology processes!



Acquandas GmbH

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Germany

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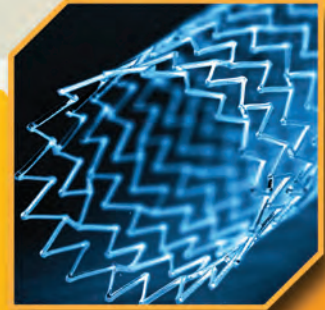
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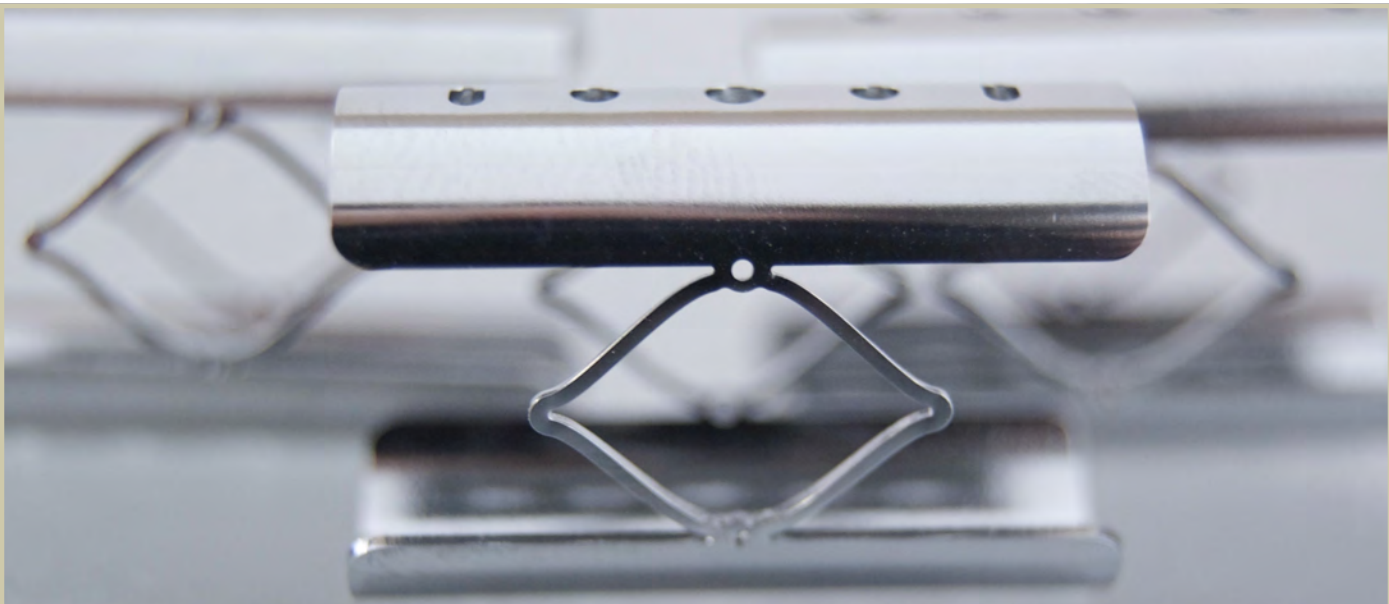




Specialty Materials for Shape Memory Applications

ATI's low-carbon, shape memory and superelastic, nickel-titanium alloys, including ATI NiTi, ATI NiTiFe™, ATI NiTiNb™, ATI NiTiHf™ and ATI Ni40Ti™ are ideal alloys for a variety of medical, aerospace, automotive and industrial applications. These products are used for medical stents, surgical guide wires and dental arches, airframe actuators and fittings as well as industrial sealing plugs and tube couplings.





Introducing the newest member of the G.RAU-Group:
G.RAU Inc.

G.RAU Inc. was founded in 2014 in Fremont, California, USA and offers materials and medical device testing and consulting services.

With a state-of-the-art facility, the company performs FEA, tensile, fatigue and corrosion testing.

G.RAU Inc. adds new medical device experience to the over 100-year-old materials-based expertise of the G.RAU-Group. With headquarters and two production plants in Pforzheim, Germany and one production plant in Costa Rica, the G.RAU-Group has an international focus for its customers.

G.RAU Inc. advises medical customers in the areas of materials selection with special emphasis on fatigue properties of the material and medical device components. Additionally, G.RAU Inc. offers consultation services on translating „in vivo“ physiology to testing protocols for regulatory submittals.

G.RAU Inc. strengthens the G.RAU-Group with its strategic focus and long-term commitment to medical technology. From material selection through development and submission into production, the G.RAU-Group offers its experience and assistance.

► www.g-rau.com

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G.RAU Inc.
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Ni-Ti (Nitinol) Alloys

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Full range of Nitinol wires and tubes of the highest-class homogeneity and purity obtained from our furnace are lined-up for medical device developments.

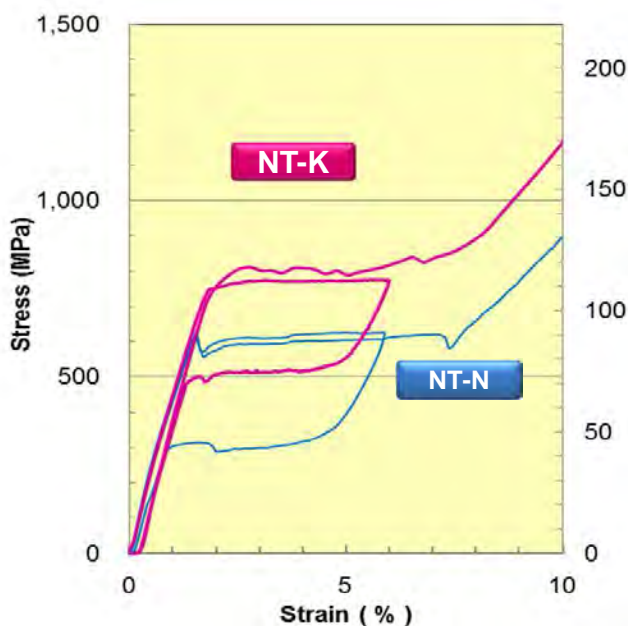
We are very much “**Flexible & Reliable**” for requirements of your ideas and concepts.



[New Super-elastic Ni-Ti-Co]



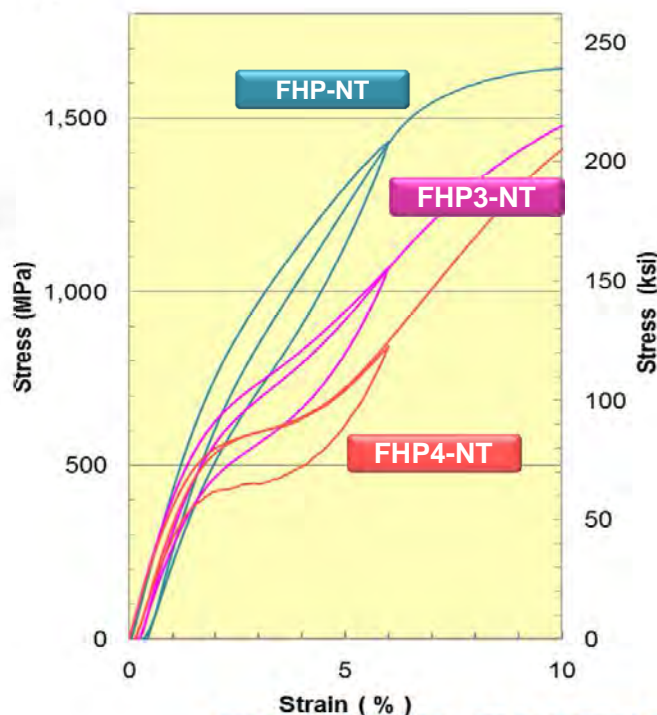
Now, let's take a look at a revolutionary Ni-Ti super-elastic alloy! Our **NT-K** wire has much higher Upper Plateau Stress than Ni-rich binary alloy. It is ideal for super-elastic Guidewires, which request ultra high stiffness.



[FHP-NT]



Furukawa recently launched a new range of FHP-NT wires, patented by Furukawa. The well-known FHP-NT wires have already penetrated the Guidewire market. Now, **FHP3-NT** and **FHP4-NT** are available to develop superior recovery performance and small stress hysteresis whilst retaining high upper stress.



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G.RAU IS AN EXPERT FOR SHAPE MEMORY ALLOYS



For more than 40 years, G.RAU has been researching and developing shape memory alloys and their applications. Quite rightly, we can call ourselves undisputed experts in this field, as we combine all manufacturing steps from the melt to the final complex part at our facilities. Besides our predominant use of nickel-titanium alloy, we also use other special materials and also are constantly in the process of expanding our product range. Assemblies made of shape memory alloys are used as thermal actuators in the automotive industry as well as in further applications of measurement and control technology, appliance technology, aviation industry as well as medical technology.

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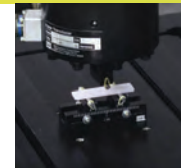
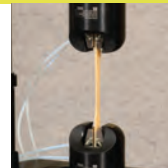
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Blue Oxide

Next Generation Surface Finish

Blue Oxide is a patented and integrated surface treatment for controlled thermal oxidation, which creates a 15-100nm oxide layer with the purest and most dense TiO_2 without causing performance fading by-products.

Blue Oxide

Benefits

- Improves corrosion resistance of Nitinol devices
- Ensures superior biocompatibility of Nitinol interface
- Minimizes short and long-term Ni-release rate

Blue Oxide

Clinical Reference

Blue Oxide is already applied for CE-marked Class III wire-based devices. It is expected to improve endothelialization, which is currently been evaluated.

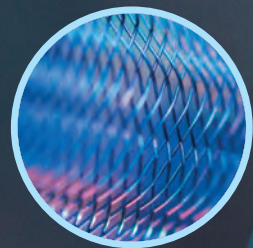
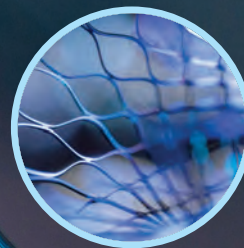
Blue Oxide

Tests and Verifications

- Corrosion Resistance per ASTM F2129-08: more than 120 wire-based devices have been tested for their corrosion behavior without resulting in any breakdown
- Chemical composition of Nitinol surface by Auger Electron Spectroscopy (AES)
- Surface Morphology Analysis (SEM + Laser Scanning Microscopy)
- Ni - release investigation per ISO 10993-18
- Contact angle measurement



Applicable to Laser Cuts + Braidings



BlueOxide - Next Generation Surface Finish

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WE DO IT **ALL** WITH NITINOL!

Norman Noble, Inc.
is your single-source
contract manufacturer
of Nitinol-based
implants and devices.

Norman Noble, Inc. is the largest contract manufacturer of Nitinol based implants and devices. Some examples of the products we manufacture for our customers include:

- **Vascular Stent Implants - Cardio, AAA, Peripheral, Neuro**
- **Transcatheter Heart Valve Implants**
- **Vena Cava Filter Implants**
- **Atrial Appendage Closure Implants**
- **Vascular Closure Implants**
- **Atrial Fibulation Devices**
- **Renal Denervation Devices**
- **Spinal Implants and Devices**
- **Extremity Screw and Plate Implants and Devices**
- **Ligament Repair Anchors and Devices**

Norman Noble, Inc.
Microprecision Medtech Manufacturing 

PRECISION MACHINING OF NITINOL

- Laser ablation, cutting and welding
- Swiss turning
- 5-axis micro milling
- EDM machining

SHAPE SETTING OF NITINOL

- Design For Manufacturing (DFM) services
- Process Development Center (PDC) for prototypes
- Engineering design of form tooling
- Validated thermal processing of superelastic and shape-memory Nitinol

ELECTROPOLISHING OF NITINOL

- Automated electropolishing systems
- Automated passivation systems

TESTING SERVICES FOR NITINOL

- Thermal testing (DSC or BFR)
- Metallurgical cross section analysis
- Force testing and analysis
- Scanning Electron Microscopy with EDX
- Partnered laboratories

PROCESS VALIDATION FOR NITINOL

- Quality engineering team provides strategy, testing and protocols
- IQ/OQ, PQ/PPQ, MSV, TMV, DOE, PFMEA
- Available for all processes, including machining, laser welding, surface finishing, cleaning and other special processes

ASSEMBLY & PACKAGING

- ISO Class 8 cleanroom
- Micro assembly and welding
- Custom packaging and labeling