

CARL P. FRICK, Ph.D.
Mechanical Engineer and Materials Science Expert

Distinguished University Professor with research and teaching emphasis in the field of mechanical behavior of materials. Performed extensive research studies focused on mechanical testing and failure analysis, covering a wide range of materials including various polymers (i.e., plastics), composites, and metal alloys. Engaged with entrepreneurship related to engineering product design and development.

PROFESSIONAL EXPERIENCE

- 2021 to present **Robson Forensic, Inc.**
Associate
Provide technical investigations, analysis, reports, and testimony toward the resolution of commercial and personal injury litigation involving failure analysis of polymers and polymer composites, fibers and fiber composites, metal alloys, glass, and ceramic systems.
- 2021 to present **Colorado School of Mines**
Department Head, Department of Mechanical Engineering 2021-present
Professor, Department of Mechanical Engineering 2021-present
Department Head activities involve managing all overarching activities of the Mechanical Engineering Department. Responsible for driving the vision, strategy, design, and implementation of department endeavors and activities. Major duties include department finances, strategic planning, faculty hiring, implementation and assessment of the curriculum, and deriving faculty job descriptions.
- Research activities involve integration of materials science, bioengineering, and mechanical engineering to characterize new materials for use in emerging technologies. Projects primarily focus on exploring the mechanical behavior of materials, with specific interests in metallic & polymer biomaterials, shape memory materials, and nanometer-scale materials.
- Frequently used equipment includes:
- Mechanical Testing: Dynamic Mechanical Analyzer (DMA), Load Frames with strain measurement and environmental chamber, Vickers Indenter, Berkovich Nano-indenter
 - Microscopy: Laser Scanning Confocal Microscope, Optical Microscopy, Scanning Electron Microscopy (SEM, EDX, EBSD, TEM)
 - Characterization: Fourier Transform Infrared Spectroscopy (FTIR), Nuclear magnetic Resonance (NMR), Thermal Gravimetric Analysis (TGA), X-Ray Diffractometer (XRD)
 - Manufacturing: Additive 3D printing (DLP, SLA, FDM, SLS), Composite Hand Lay-Up, Filament Winder
- 2017 to present **Impressio, Inc.**
Senior Advisor and Co-founder
12-person start-up focused on padding for helmets & orthopedic devices using energy-absorbing liquid crystalline elastomers developed from basic research. Responsibilities include product conceptualization & development, experimentation, fundraising & grant writing, and customer discovery.

THE EXPERTS
Robson Forensic

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- 2017 to present **K1C, LLC**
Principal, Partner, and Co-founder
Engineering and scientific consulting firm focused on guiding clients through product design, from napkin-sketch concept to final design with documentation. Primary roles are materials selection, prototype manufacturing (including 3D printing and machining), and design verification & validation testing. Also responsible for new business development, project management, and strategic planning.
- 2008 to 2021 **University of Wyoming**
Department Head, Department of Mechanical Engineering 2015-2021
Professor, Department of Mechanical Engineering 2019-2021
Associate Professor, Department of Mechanical Engineering 2014-2019
Assistant Professor, Department of Mechanical Engineering 2008-2014
Principal Investigator for several materials engineering research projects. Research investigations involve a combination of mechanical engineering and materials science, with a focus on developing processing-structure-property relationships for novel materials and additive manufacturing techniques from prototyping through manufacturing.

Research activities involved integration of materials science, bioengineering, and mechanical engineering to characterize new materials for use in emerging technologies. Projects primarily focused on exploring the mechanical behavior of materials, with specific interests in metallic & polymer biomaterials, shape memory materials, and nanometer-scale materials.
- 2007 to 2008 **Abbott Vascular**
Senior Engineer, Research Department
Industry leader in medical equipment & supplies manufacturing industry. Primary responsibility was team leader for development of novel metallic alloy to be used as next generation vascular stent material. Custom alloy tailored to exhibit superior radiopacity and magnetic resonance imaging, while maintaining optimal mechanical properties and biocompatibility. Also acted as a consultant for other ongoing materials related medical device research projects. Specific examples include troubleshooting and failure analysis of vessel closure devices, peripheral stents, and a stem-cell-delivery catheter.
- 2006 to 2007 **Max Planck Institute for Metals Research**
Postdoctoral Visiting Scientist, Department Arzt: Micro/nanomechanics
There are over 80 Max Planck Institutes, mostly located in Germany, which concentrate on conducting basic research. Served as lead experimental researcher responsible for investigating deformation behavior at the nanoscale by uniaxially compressing pillar samples of decreasing size. Method involved machining pillars from bulk material using a focused ion beam (FIB) technique and applying force with a nanoindenter equipped with a flat punch. Pre- and post-mortem analysis is conducted with electron microscopy and x-ray diffraction (TEM, SEM, EBSD).

EDUCATION

Ph.D., Mechanical Engineering, University of Colorado at Boulder, 2005
B.S., Mechanical Engineering, University of Colorado at Boulder, 1999

PEER-REVIEWED JOURNAL PUBLICATIONS

Google Scholar Citation Indices: Total Citations (2760) h-index (24) i10-index (37)

R.K. Shaha, A.H. Torbati, C.P. Frick (2020) "Body-Temperature Shape-Shifting Liquid Crystal Elastomers", *Journal of Applied Polymer Science*, DOI: 10.1002/app.50136.

A. Elgohary, E. Block, J. Squier, M. Koneshloo, R.K. Shaha, C.P. Frick, J.S. Oakey, S.A. Aryana (2020) "Fabrication of sealed sapphire microfluidic devices using femtosecond laser micromachining", *Applied Optics*, DOI: 10.1364/AO.400184.

C.M. Laursen, N.J. Peter, G. Gerstein, H.J. Maier, G. Dehm, C.P. Frick (2020) "Influence of Ti₃Ni₄ Precipitates on the Indentation-Induced Two-Way Shape-Memory Effect in Nickel-Titanium", *Materials Science and Engineering A*, DOI: 10.1016/j.msea.2020.139373.

R.K. Shaha, D.R. Merkel, M.P. Anderson, E.J. Devereaux, R.R. Patel, A.H. Torbati, N. Willett, C.M. Yakacki, C.P. Frick (2020) "Biocompatible Liquid-Crystal Elastomers Mimic the Intervertebral Disc", *Mechanical Behavior of Biomedical Materials*, DOI: 10.1016/j.jmbbm.2020.103757.

Y. Liu, A. Hansen, R.K. Shaha, C.P. Frick, J.S. Oakey (2020) "Bench scale glass-to-glass bonding for microfluidic prototyping", *Microsystem Technologies*, DOI: 10.1007/s00542-020-04819-4.

Z. Jiang, R.K. Shaha, R. McBride, K. Jiang, M. Tang, B. Xu, A.K. Goroncy, C.P. Frick, J.S. Oakey (2020) "Crosslinker length dictates step-growth hydrogel network formation dynamics and allows rapid on-chip photoencapsulation", *Acta Biomaterialia*, DOI: 10.1088/1758-5090/ab7ef4.

R.K. Shaha, Z. Jiang, C.P. Frick, J.S. Oakey (2019) "Cell-laden Particulate-Composite Hydrogels with Tunable Mechanical Properties Constructed with Gradient-Interface Hydrogel Particles", *ACS Applied Polymer Materials*, DOI: 10.1021/acsapm.9b00606.

D.R. Merkel, R.K. Shaha, C.P. Frick (2019) "Mechanical energy dissipation in polydomain nematic liquid crystal elastomers in response to oscillating loading", *Polymer*, DOI: 10.1016/j.polymer.2019.01.042.

C.M. Laursen, M.P. Anderson, C.P. Frick (2019) "Extended cyclic deformation recovery of the indentation-induced two-way shape-memory effect in nickel-titanium", *Advanced Engineering Materials*, DOI: 10.1002/adem.201801020.

A.L. Cordes, D.R. Merkel, V.J. Patel, C. Courtney, M. McBride, C.M. Yakacki, C.P. Frick (2019) "Mechanical Characterization of Polydopamine-Assisted Silver Deposition on Thiol-Ene Polymer Substrates", *Surface and Coatings Technology*, DOI: 10.1016/j.surfcoat.2018.11.016.

S.A. Brinckmann, N. Patra, J. Yao, T.H. Ware, C.P. Frick, R.S. Fertig (2018) "Stereolithography of SiOC/SiC Polymer-Derived Ceramic Matrix Composites", *Advanced Engineering Materials*, DOI: 10.1002/adem.201800593.

D.R. Merkel, N.A. Traugott, R. Visvanathan, C.M. Yakacki, C.P. Frick (2018) "Thermomechanical Properties of Monodomain Nematic Main-Chain Liquid Crystal Elastomers", *Soft Matter*, DOI: 10.1039/c8sm01178h.

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Mechanical Engineer and Materials Science Expert

- R.R. Patel, A. Noshchenko, R.D. Carpenter, T. Baldini, C.P. Frick, V.V. Patel, C.M. Yakacki (2018) "Evaluation and Prediction of Human Lumbar Vertebrae Endplate Mechanical Properties Using Indentation and Computed Tomography" *Journal of Biomechanical Engineering*, DOI: 10.1115/1.4040252.
- A. Hyunhee, R.R. Patel, A.J. Hoyt, A.S.P. Lin, F.B. Torstrick, R.E. Guldborg, C.P. Frick, R.D. Carpenter, C.M. Yakacki, N.J. Willett (2018) "Biological evaluation and finite-element modeling of porous poly (para-phenylene) for orthopaedic implants" *Acta Biomaterialia*, DOI: 10.1016/j.actbio.2018.03.025.
- S.A. Brinckmann, N. Lakhera, C.M. Laursen, C.M. Yakacki, C.P. Frick (2018) "Characterization of Poly(para-phenylene)-MWCNT Solvent-Cast Composites" *AIMS Materials Science*, DOI: 10.3934/MATERSCI.2018.2.301.
- D.R. Merkel, C.M. Laursen, R. Rorrer, C.M. Yakacki, C.P. Frick (2017) "Characterization and Mechanical Testing of Polydopamine-Adhered Electroless Copper Films" *Surface and Coatings Technology*, DOI: 10.1016/j.surfcoat.2017.10.008.
- C.P. Frick, D.R. Merkel, C.M. Laursen, S.A. Brinckmann, C.M. Yakacki (2016) "Copper-Coated Liquid-Crystalline Elastomer via Bioinspired Polydopamine Adhesion and Electroless Deposition" *Macromolecular Rapid Communications*, DOI: 10.1002/marc.201600363.
- S.A. Brinckmann, M. Frensemeier, C.M. Laursen, H.J. Maier, D. Britz, A.S. Schneider, F. Mücklich, C.P. Frick (2016) "Effect of Indentation Temperature on Nickel-Titanium Indentation-Induced Two-Way Shape-Memory Surfaces" *Materials Science and Engineering A*, DOI: 10.1016/j.msea.2016.08.036.
- C.M. Laursen, J.A. Brant, C.P. Frick (2016) "A methodology for fabrication of thermomechanically activated switchable surface wettability", *Journal of Applied Polymer Science*, DOI: 10.1002/app.44122.
- D.L. Safranski, J.M. Boothby, C.N. Kelly, K. Beatty, N. Lakhera, C.P. Frick, A. Lin, R.E. Guldborg, J.C. Griffis (2016) "Thermo-mechanical Behavior and Structure of Melt Blown Shape-Memory Polyurethane Nonwovens". *Journal of the Mechanical Behavior of Biomedical Materials*, DOI: 10.1016/j.jmbbm.2016.05.038.
- R. Xiao, C.M. Yakacki, J. Guo, C.P. Frick, T.D. Nguyen (2016) "A Predictive Parameter for the Shape Memory Behavior of Thermoplastic Polymers". *Journal of Polymer Science Part B: Polymer Physics*, DOI: 10.1002/polb.23981.
- D.A. Collins, C.M. Yakacki, D. Lightbody, R. Patel, C.P. Frick (2016) "Shape-Memory Behavior of High-Strength Amorphous Thermoplastic Poly(para-phenylene)". *Journal of Applied Polymer Science*, DOI: 10.1002/app.42903.
- M. Frensemeier, J.S. Kaiser, C.P. Frick, A.S. Schneider, E. Arzt, R.S. Fertig III, E. Kroner (2015) "Temperature-Induced Switchable Adhesion using Nickel-Titanium-Polydimethylsiloxane Hybrid Surfaces". *Advanced Functional Materials*, DOI: 10.1002/adfm.201500437.
- M. Frensemeier, E. Arzt, E. Qin, C.P. Frick, A.S. Schneider (2015) "Indentation-induced two-way shape-memory effect in aged Ti-50.9 at.% Ni". *MRS Communications*, DOI: 10.1557/mrc.2014.37.
- A.J. Hoyt, C.M. Yakacki, R.S. Fertig III, R.D. Carpenter, C.P. Frick (2015) "Monotonic and Cyclic Loading Behavior of Porous Scaffolds made from Poly(para-phenylene) for Orthopedic Applications". *Journal of the Mechanical Behavior of Biomedical Materials*, DOI: 10.1016/j.jmbbm.2014.10.004.

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- C.P. Frick, A.L. DiRienzo, A.J. Hoyt, D.L. Safranski, M. Saed, E. Losty, C.M. Yakacki (2014) "High-Strength Poly(para-phenylene) as an Orthopedic Biomaterial". *Journal of Biomedical Materials Research A*, DOI: 10.1002/jbm.a.34982.
- E. Qin, N.J. Peter, M. Frensemeier, C.P. Frick, E. Arzt, A.S. Schneider (2014) "Vickers indentation induced one-way and two-way shape memory effect in austenitic NiTi". *Advanced Engineering Materials*, DOI: 10.1002/adem.201300219.
- A.L. DiRienzo, C.M. Yakacki, M. Frensemeier, A.S. Schneider, D.L. Safranski, A.J. Hoyt, C.P. Frick (2014) "Porous Poly(para-phenylene) Scaffolds for Load-Bearing Orthopedic Applications". *Journal of the Mechanical Behavior of Biomedical Materials*, DOI: 10.1016/j.jmbbm.2013.10.012.
- A.C. Martin, N. Lakhera, A.L. DiRienzo, D.L. Safranski, A.S. Schneider, C.M. Yakacki, C.P. Frick (2013) "Amorphous-to-Crystalline Transition of Polyetheretherketone-Carbon Nanotube Composites via Resistive Heating". *Composites Science and Technology*, DOI: 10.1016/j.compscitech.2013.09.012.
- C.K. Hossfeld, A.S. Schneider, E. Arzt, C.P. Frick (2013) "Detachment Behavior of Mushroom-Shaped Fibrillar Adhesive Surfaces in Peel Testing". *Langmuir*, DOI: 10.1021/la402838y.
- R. Xiao, N. Lakhera, J. Choi, C.M. Yakacki, C.P. Frick, T.D. Nguyen (2013) "Modeling the Glass Transition of Amorphous Networks for Shape-Memory Behavior". *Journal of the Mechanics and Physics of Solids*, DOI: 10.1016/j.jmps.2013.02.005.
- A.S. Schneider, C.P. Frick, E. Arzt, W.J. Clegg, S. Korte (2013) "Influence of test temperature on the size effect in molybdenum small-scale compression pillars". *Philosophical Magazine Letters*, DOI: 10.1080/09500839.2013.777815.
- N. Lakhera, K.E. Smith, C.P. Frick (2013) "Systematic tailoring of water absorption in photopolymerizable meth(acrylate) networks and its effect on mechanical properties". *Journal of Applied Polymer Science*, DOI: 10.1002/app.38371.
- N. Lakhera, A. Graucob, A.S. Schneider, E. Kroner, E. Arzt, C.P. Frick (2013) "Effect of viscoelasticity on the spherical and flat adhesion characteristics of photopolymerizable acrylate polymer networks". *International Journal of Adhesion and Adhesives*, DOI: 10.1016/j.ijadhadh.2013.02.016.
- N. Lakhera, A. Graucob, A.S. Schneider, E. Kroner, M. Micciche, E. Arzt, C.P. Frick (2013) "Adhesion behavior of polymer networks with tailored mechanical properties using spherical and flat contacts". *MRS Communications*, DOI: 10.1557/mrc.2013.3.
- A.S. Schneider, D. Kiener, C.M. Yakacki, H.J. Maier, P.A. Gruber, N. Tamura, M. Kunz, A.M. Minor C.P. Frick (2012) "Influence of bulk pre-straining on the size effect in nickel compression pillars". *Materials Science and Engineering A*, DOI: 10.1016/j.msea.2012.08.055.
- C.M. Yakacki, A.M. Ortega, C.P. Frick, N. Lakhera, R. Xiao, T.D. Nguyen (2012) "Unique Recovery Behavior in Amorphous Shape-Memory Polymer Networks". *Macromolecular Materials and Engineering*, DOI: 10.1002/mame.201200275.
- N. Lakhera, C.M. Yakacki, T.D. Nguyen, C.P. Frick (2012) "Partially constrained recovery of (meth)acrylate shape-memory polymer networks". *Journal of Applied Polymer Science*, DOI: 10.1002/app.36612.

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- N. Lakhera, C.M. Laursen, D.L. Safranski, C.P. Frick (2012) "Biodegradable thermoset shape-memory polymer developed from poly (β -amino ester) networks". *Journal of Polymer Science Part B: Polymer Physics*, DOI: 10.1002/polb.23059.
- A.S. Schneider, C.P. Frick, B.G. Clark, P.A. Gruber, E. Arzt (2011) "Influence of Orientation on the Size Effect in BCC pillars with Different Critical Temperatures". *Materials Science and Engineering A*, DOI: 10.1016/j.msea.2010.10.073.
- B.G. Clark, D.S. Gianola, O. Kraft, C.P. Frick (2010) "Size Independent Shape Memory Behavior of Nickel-Titanium". *Advanced Engineering Materials*, DOI: 10.1002/adem.201000048.
- B. Girault, A.S. Schneider, C.P. Frick, E. Arzt (2010) "Strength Effects in Micropillars of a Dispersion Strengthened Superalloy". *Advanced Engineering Materials*, DOI: 10.1002/adem.201000089.
- C.P. Frick, B.G. Clark, A.S. Schneider, R. Maaß, S. Van Petegem, H. Van Swygenhoven (2010) "On the Plasticity of Small-Scale Nickel-Titanium Shape Memory Alloys". *Scripta Materialia*, DOI: 10.1016/j.scriptamat.2009.12.023.
- A.S. Schneider, B.G. Clark, C.P. Frick, P.A. Gruber, E. Arzt (2010) "Effect of Pre-Straining on the Size Effect for Molybdenum Pillars". *Philosophical Magazine Letters*, DOI: 10.1080/09500839.2010.508445.
- A.S. Schneider, D. Kaufmann, B.G. Clark, C.P. Frick, P.A. Gruber, R. Mönig, O. Kraft, E. Arzt (2009) "Correlation between critical temperature and strength of small-scale bcc pillars". *Physical Review Letters*, DOI: 10.1103/PhysRevLett.103.105501.
- A.S. Schneider, B.G. Clark, C.P. Frick, P.A. Gruber, E. Arzt (2009) "Effect of Orientation and Loading Rate on Compression Behavior of Small-Scale Mo Pillars". *Materials Science and Engineering A*, DOI: 10.1016/j.msea.2009.01.011.
- M. Zaiser, J. Schwerdtfeger, A.S. Schneider, C.P. Frick, B.G. Clark, P.A. Gruber, E. Arzt (2008) "Strain bursts in plastically deforming Molybdenum micro- and nanopillars", *Philosophical Magazine*, DOI: 10.1080/14786430802132522.
- C.P. Frick, B.G. Clark, S. Orso, P. Sonnweber-Ribic, E. Arzt (2008) "Orientation-independent pseudoelasticity in small-scale NiTi compression pillars", *Scripta Materialia*, DOI: 10.1016/j.scriptamat.2008.01.051.
- C.P. Frick, B.G. Clark, S. Orso, A.S. Schneider, E. Arzt (2008) "Size Effect on Strength and Strain Hardening of [111] Nickel Sub-Micron Compression Pillars". *Materials Science and Engineering A*, DOI: 10.1016/j.msea.2007.12.038.
- C.P. Frick, S. Orso, E. Arzt (2007) "Loss of Pseudoelasticity in Nickel-Titanium Sub-Micron Compression Pillars". *Acta Materialia*, DOI: 10.1016/j.actamat.2007.02.034.
- C.P. Frick, T.W. Lang, K. Spark, K. Gall (2006) "Stress-Induced Martensitic Transformations and Shape Memory at Nanometer Scales". *Acta Materialia*, DOI: 10.1016/j.actamat.2006.01.030.
- K. Gall, J. Tyber, V. Brice, C.P. Frick, H. J. Maier, N. Morgan (2005) "Tensile Deformation of NiTi Wires". *Journal of Biomedical Materials Research A*, DOI: 10.1002/jbm.a.30464.

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C.P. Frick, A.M. Ortega, J. Tyber, H.J. Maier, A. El. M. Maksound, Y. Liu, K. Gall (2005) "Thermal Processing of Polycrystalline NiTi Shape-Memory Alloys". *Materials Science and Engineering A*, DOI: 10.1016/j.msea.2005.05.102.

A.M. Ortega, J. Tyber, C.P. Frick, K. Gall, H.J. Maier (2005) "Cast NiTi Shape Memory Alloys". *Advanced Engineering Materials*, DOI: 10.1002/adem.200400173.

C.P. Frick, A. M. Ortega, J. Tyber, K. Gall, H. J. Maier (2004) "Multiscale Structure and Properties of Cast and Deformation Processed Polycrystalline NiTi Shape-Memory Alloys". *Metallurgical and Materials Transactions A*, DOI: 10.1007/s11661-004-0150-4.

BOOK CHAPTER

K.E. Smith, C.P. Frick, D.L. Safranski, C.M. Yakacki, K. Gall, (2013) "Active Materials", *Biomedical Technology and Devices*, Second Edition, CRC Press, Chapter 16: 393-432.

PATENTS

J. Oakey, K.D. Li-Oakey, D. Debroy, C.P. Frick, R. Shaha, "Exploiting Oxygen Inhibited Photopolymerization within Emulsion Droplets for the Fabrication of Microparticles with Customizable Properties", US20200254417A1, Publication Date: August 13, 2020.

R. Bregulla, R. von Oepen, P.A. Kramer-Brown, C.P. Frick, and A.M. Leach, "Partially Annealed Stent", International, WO2013055491A1, Publication Date: April 18, 2013.

W.E. Cornish, T.R. Yribarren, C.P. Frick, J.M. Saenz, E.C. Biagtan, P. Buan, D.H. Burkett, J.J. Nelson, R.J. Peralta, M.E. Alexander, A.R. Tyre, J.A. Simpson, "Color coded Guide Wire and Methods of Making Same", Pub. No.: US 2012/0065622 A1, Publication Date: March 15, 2012.

PEER-REVIEWED CONFERENCE PROCEEDINGS

B.E. Noren, R.K. Shaha, A.T. Stenquist, C.P. Frick, J.S. Oakey (2019) "Cell Printing in Complex Hydrogel Scaffolds", *IEEE Transactions on NanoBioscience*, DOI: 10.1109/TNB.2019.2905517

Z. Jiang, R.K. Shaha, K. Jiang, R. McBride, C.P. Frick, J.S. Oakey (2019) "Composite hydrogels with controlled degradation in 3D printed scaffolds for programmed cell delivery", *IEEE Transactions on NanoBioscience*, DOI: 10.1109/TNB.2019.2905510

H. Ahn, R. Patel, A.J. Hoyt, A.S. Lin, B. Torstrick, R.E. Guldborg, C.P. Frick, R.D. Carpenter, C.M. Yakacki, N.J. Willett (2017) "Development of Biological and Mechanical Evaluation of Porous poly(para-phenylene) for orthopedic implants", *Tissue Engineering Part A*, TERMIS - Americas Conference and Exhibition, DOI: 10.1089/ten.tea.2017.29003.abstracts

N.J. Peter, M. Frensemeier, E. Qin, C.P. Frick, E. Arzt, A.S. Schneider (2013) "Microstructure dependent indentation induced two-way shape-memory effect in NiTi", *The 8th Annual IEEE International Conference on Nano/Micro Engineered and Molecular Systems*, DOI: 10.1109/NEMS.2013.6559921.

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A.L. DiRienzo, C.M. Yakacki, D.L. Safranski, C.P. Frick, (2013) "Tensile Behavior of Porous Scaffolds made from Poly(para-phenylene)", Biomedical - 50th Annual Biomedical Sciences Instrumentation Symposium, PMID: 23686195.

N. Lakhera, A. Graucob, A.S. Schneider, E. Kroner, C.M. Yakacki, C.P. Frick, (2013) "Thermally Switchable Adhesion of Photopolymerizable Acrylate Polymer Networks", Biomedical - 50th Annual Biomedical Sciences Instrumentation Symposium, PMID: 23686193.

C.P. Frick, N. Lakhera, C.M. Yakacki, (2011) "Thermo-mechanical Behavior of (Meth)Acrylate Shape-Memory Polymer Networks", Materials Research Society (MRS) Symposium Proceedings, DOI: 10.1557/opl.2011.913.

A.S. Schneider, B.G. Clark, C.P. Frick, E. Arzt, (2009) "Correlation between Activation Volume and Pillar Diameter for Mo and Nb BCC Pillars", Materials Research Society (MRS) Symposium Proceedings, DOI: 10.1557/PROC-1185-II07-04.

C.P. Frick, T.W. Lang, K. Spark, K. Gall (2008) "Stress-Induced Martensitic Transformations and Shape Memory at Nanometer Scales", Proceedings of the International Conference on Shape Memory and Superelastic Technologies (SMST), DOI: 10.1361/cp2006smst099.

C.P. Frick, T.W. Lang, K. Spark, K. Gall (2006) "Shape Memory at Nanometer Scales", Materials Research Society (MRS) Symposium Proceedings, DOI: 10.1557/PROC-0888-V04-07.

C.P. Frick, A.M. Ortega, J. Tyber, K. Gall, H.J. Maier, A. El. M. Maksound, Y. Liu (2005) "Thermal Processing of Polycrystalline NiTi Shape Memory Alloys", Materials Research Society (MRS) Symposium Proceedings, DOI: 10.1557/PROC-855-W1.9.

A.M. Ortega, C. P. Frick, J. Tyber, K. Gall, H. J. Maier (2005) "Cast NiTi Shape Memory Alloys", Materials Research Society (MRS) Symposium Proceedings, DOI: 10.1557/PROC-855-W1.8.

H.J. Maier, C.P. Frick, A.M. Ortega, K. Gall, J. Tyber, A. El. M. Maksound (2004) "Microstructure-Property Relationships in Polycrystalline NiTi Shape Memory Alloys", Proceedings of the International Conference on Shape Memory and Superelastic Technologies (SMST), edited by M. Mertmann, pp. 15-20.

J. Tyber, K. Gall, C.P. Frick, A.M. Ortega, D. Pacaccio (2004) "Improved Fracture Healing with Use of Shape Memory Alloys", ASM Materials and Processes for Medical Devices II (MPMD) Proceedings, edited by M. Helmus and D. Medlin, pp. 124-127.

C.P. Frick, A.M. Ortega, J. Tyber, H.J. Maier, A. El. M. Maksound, Y. Liu, K. Gall (2004) "Thermal Processing of Polycrystalline NiTi Shape-Memory Alloys", ASM Materials and Processes for Medical Devices II (MPMD) Proceedings, edited by M. Helmus and D. Medlin, pp. 32-37.

K. Gall, C.P. Frick, A.M. Ortega, J. Tyber, H.J. Maier (2003) "Fatigue and Asymmetric Deformation of NiTi Shape Memory Alloys", ASM Materials and Processes for Medical Devices (MPMD) Proceedings, edited by S. Shrivastava, pp. 193-198.

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INVITED TALKS

“High Strength Poly (para-phenylene) for use as an Orthopedic Spinal Implant”, February 2018, Wyoming Engineering Society, Laramie, WY.

“Characterization of Porous Poly (para-phenylene) for use as a Spinal Implant Device”, June 2015, University of Saarland, Saarbruecken, Germany.

“Recent Advancements in Nickel-Titanium Two-Way Shape-Memory Surfaces”, June 2015, University of Saarland, Saarbruecken, Germany.

“Recent Advancements in Shape-Memory Polymers”, January 2014, Rocky Mountain Materials Research Society, Boulder, CO.

“Experimental Investigation of Self-Reinforced Polyphenylene for use as a Porous Scaffold Biomaterial”, November 2013, Colorado State University, Fort Collins, CO.

“Experimental Approach Towards Understanding Indentation Induced Two-Way Shape-Memory Surfaces Made from Nickel-Titanium Alloys”, February 2013, University of Colorado Denver, Denver, CO.

“Recent Advances in Shape-Memory Materials”, July 2010, Leibniz Institute for New Materials, Saarbrücken, Germany.

“Compression Behavior of Body Center Cubic Metals at Small Scales”, University of Colorado, August 2009, Boulder, CO.

“Compression of Nickel-Titanium (NiTi) Shape Memory Alloys at Multiple Length Scales”, Boise State University, February 2008, Boise, ID.

“Deformation of Small-Scale Nickel-Titanium Compression Pillars”, University of Wyoming, February 2008, Laramie, WY.

“Linking Standard Processing Practice to Structure and Properties in NiTi Shape Memory Alloys at Multiple Length Scales”, Abbott Vascular, June 2007, Santa Clara, CA.

“Loss of Pseudoelasticity in Nickel-Titanium Sub-Micron Compression Pillars”, General Motors Research and Development Center, June 2007, Warren, MI.

“Deformation of Nickel and Pseudoelastic Nickel-Titanium Sub-Micron Compression Pillars”, University of Minnesota, March 2007, Minneapolis, MN.

“Loss of Pseudoelasticity in Nickel-Titanium Sub-Micron Compression Pillars”, University of Kentucky, March 2007, Lexington, KY.

“Deformation of Nickel-Titanium (NiTi) Shape Memory Alloy Sub-Micron Compression Pillars”, Colorado School of Mines, November 2006, Golden, CO.

“Nanoindentation of NiTi Shape Memory Alloys”, Iowa State University, April 2006, Ames, IA.

CARL P. FRICK, Ph.D.
Mechanical Engineer and Materials Science Expert

“Nanoindentation of NiTi Shape Memory Alloys”, Georgia Institute of Technology, November 2005, Atlanta, GA.

“Thermal Processing and Nanoindentation of NiTi Shape Memory Alloys”, Max Planck Institute for Metals Research, November 2005, Stuttgart, Germany.

FEDERAL GRANT FUNDING

“Development of Additive Manufacturing for Ceramic Matrix Composite Vanes” Department of Energy (DOE). Lynch (PI), Hickner, Frick, Fertig (co-PIs). 9/19-8/22

“PFI-TT: Tailored Total Intervertebral Disc Replacement Device using Ultra-Dissipative Liquid-Crystalline Elastomers” National Science Foundation (NSF). Frick (PI), Yakacki & Torbati (subaward-PIs). 9/18-3/20

“I-CORPS: Energy Absorbing Device made from Liquid Crystalline Elastomer / Nickel-Titanium Shape-Memory Alloy (LCE/NiTi) Composite Material” National Science Foundation (NSF). Frick (PI), Anderson (EL), Jacobus (IM). 7/18-12/18

“Consortium for Production of Affordable Carbon Fibers in the United States” Department of Energy (DOE), University of Wyoming subaward. Fertig (PI), Frick (co-PI). 9/17-9/20

“CAREER: Experimental Investigation of Indentation-Induced Two-Way Shape-Memory Surfaces Made from Nickel-Titanium Alloys” National Science Foundation (NSF). Frick (PI). 5/13-5/18

“Porous, Patient Specific Interbody Fusion Cages with Enhanced Loading Characteristics to Reduce Subsidence” National Institutes of Health (NIH). Yakacki (PI), Carpenter, Noshchenko, Patel (co-PIs), Frick (subaward-PI). 4/14-4/16

“MRI: Acquisition of a Nano-Indenter to Improve the Nanoscale Materials Testing and Characterization Capabilities at the University of Wyoming” National Science Foundation (NSF). Han (PI), Frick, Jun, Fan, Radosz (co-PIs). 9/11-9/13

COMPETITIVE INTERNAL FUNDING

“Additive Manufacturing of NiTiHf Shape-Memory Alloys” Wyoming NASA EPSCoR. Zhang & Frick (co-PIs). 6/21-5/22

“Manufacturing and Mechanical Characterization of Pitch-Based Carbon Fiber” Carbon Engineering Initiative, School of Energy Resources, University of Wyoming. Frick (PI). 7/19-6/21

“3D Printing of Ceramic Matrix Composite Gas Turbine Engine Blades” Wyoming NASA Space Grant Consortium. Frick (PI). 6/19-6/20

“Development of High-Temperature High-Resilience Silicon Carbide Microstructures via 3D Printing” Carbon Engineering Initiative, School of Energy Resources, University of Wyoming. Frick & Fertig (co-PIs). 7/16-6/18

THE EXPERTS
Robson Forensic

CARL P. FRICK, Ph.D.
Mechanical Engineer and Materials Science Expert

- “Electroless Deposition of Metallic Thin-Films” Wyoming NASA Space Grant Consortium. Frick (PI). 6/16-5/17
- “Removable and Replaceable Glaucoma Treatment Device Pilot Study” Institutional Development Award (IDeA), National Institutes of Health (NIH). Frick (PI). 10/15-4/17
- “Mechanical Characterization of PPP-MWCNT Composites” School of Energy Resources, University of Wyoming. Frick (PI). 5/16-9/16
- “Early Damage Detection of Composites Using Mechanochromic Fluorescent Materials” Wyoming NASA EPSCoR. Frick (PI). 6/15-5/16
- “Shape-Switching Liquid-Crystalline Elastomer Foams” Wyoming NASA EPSCoR. Frick (PI). 6/14-6/15
- “High-Strength Shape-Memory Composites” University of Wyoming Energy Graduate Assistantship. Frick (PI). \$58,552 available for MS student stipend, tuition, & fees (9/13-5/15)
- “Experimental Investigation of Ductility Mechanisms in B2 Intermetallics” Wyoming NASA Space Grant Consortium. Frick (PI). 7/13-7/14
- “Micro-Patterned Membrane Surfaces with Switchable Hydrophobicity” Wyoming Water Research Program (WRP) sponsored by the U.S. Geological Survey (USGS) and the Wyoming Water Development Commission (WWDC). Frick (PI), Brant (co-PI). 3/13-2/15
- “Bio-Inspired Adhesive Surfaces Made from Micro-Patterned Acrylate-Based Polymers” Wyoming NASA Space Grant Consortium. Frick (PI). 7/12-7/13
- “Micro-patterned Thermally Switchable Adhesive Surface” University of Wyoming Faculty Grant-In-Aid Program. Frick (PI). 7/12-7/13
- “Proof-of-concept development of high strength shape-memory polymer composites” Wyoming NASA Space Grant Consortium. Frick (PI). 5/11-4/12
- “Size Dependent Compressive Behavior of Body Centered Cubic Metals” Wyoming NASA Space Grant Consortium. Frick (PI). 5/10-4/11
- “Manufacturing of Shape Memory Alloy Switchable Surfaces” University of Wyoming, International Travel Grant. Frick (PI). 6/10-6/11

TEACHING & MENTORING EXPERIENCE

Instructor, University of Wyoming

- Undergraduate Courses:
 - Orientation to Engineering (ES 1000)
 - Mechanics of Materials (ES 2410)
 - Engineering Experimentation (ME 3005)
 - Properties of Engineering Materials (ME 3450)
 - Mechanical Behavior of Materials (ME 4150)
 - Introduction to Composite Materials (ME 4210)

- Graduate Courses:
 - Advanced Materials Science (ME 5432)
 - Failure of Engineering Materials (ME 5435)

Primary Advisor, University of Wyoming

- 4 PhD student dissertations
- 10 MS student theses
- 50+ Undergraduate students involved with laboratory research

PROFESSIONAL SERVICE ACTIVITIES

Proposal Reviewer:

Department of Energy, 2014, 2020, 2021

National Science Foundation, 2009, 2013, 2018, 2019

Wyoming NASA Consortium, 2011, 2012, 2013, 2014, 2015, 2016, 2019

Journal Paper Reviewer:

ACS Macro Letters, 2015

ACS Applied Materials and Interfaces, 2017-2018

Acta Biomaterialia, 2014-2015

Advanced Functional Materials, 2016, 2017

Advanced Engineering Materials, 2012

ASME Journal of Engineering Materials and Technology, 2009, 2010, 2017, 2018

Experimental Mechanics, 2016

Experimental Techniques, 2008-2010

International Journal of Applied Ceramic Technology, 2019

Journal of Biomedical Materials Research: Part A, 2014

Journal of Composite Materials, 2008

Journal of Materials Research, 2006, 2009, 2011, 2015, 2020

Journal of the Mechanical Behavior of Biomedical Materials, 2011-2019

Journal of Polymer Science, Part B: Polymer Physics, 2013, 2015

Materials & Design, 2017-2019

Materials Letters, 2016

Materials Science and Engineering A, 2013

Metallurgical and Materials Transactions A, 2004

Nanoscale, 2013

Nature Materials, 2016, 2017

Philosophical Magazine Letters, 2010

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Mechanical Engineer and Materials Science Expert

Polymer, 2011
Polymer Reviews, 2012
RSC Advances, 2019
Scientific Reports, 2019
Smart Materials and Structures, 2015, 2016, 2018, 2019
Shape Memory and Superelasticity, 2016
Techniques in Orthopaedics, 2017

University of Wyoming Service Activities:

Engineering Academic Programs Committee, 2015-2018 & 2021-present
Engineering Summer Program Instructor, 2010-2017
Graduate Coordinator, 2009-2015
Faculty Senate Member, 2008-2011
Symposium Co-organizer, Materials Research Society (MRS), Fall Meeting, November 2007

EXPERT NOT RETAINED