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Status: Permanent Resident

KEYWORDS

Materials Sciences, Fracture Mechanics, Failure Analysis, Fracture, Fatigue, Deformation, Medical Devices, Biomechanics, Biological Materials, Biomimetic, Ceramics, Intermetallics, Metals, Metallic Glasses, Composites, Polymers, Advanced Structural Materials

PROFESSIONAL PROFILE

Dr. Maximilien E. Launey is currently a postdoctoral research fellow at the Lawrence Berkeley National Laboratory and the University of California Berkeley. His research focuses on the mechanical behavior (e.g., deformation, fracture, and fatigue) of engineering and structural materials. Currently working with Professor Robert O. Ritchie, his work specifically focuses on the synthesis and characterization of novel bio-inspired hybrid structural ceramic materials, as well as on the mechanical behavior of biological and biomaterials. Also, he is currently collaborating with Professor William L. Johnson at the California Institute of Technology on the development of a new class of metallic glass matrix composites with unprecedented damage tolerance properties. His current and past projects include:

- Synthesis and characterization of a new generation of bio-inspired lightweight hybrid structural material
- Mechanical behavior of biological materials and biomaterials (bone, teeth, nacre, antler)
- Fatigue and fracture properties of bulk metallic glasses and their composites
- Failure analysis of medical devices and implants
- Fatigue and fracture properties of Mo-Si-B alloys for ultrahigh-temperature structural applications
- Grain-boundary segregation and precipitation of the hydrogen susceptibility of Nickel and steel.
- Thermodynamic and kinetic properties of amorphous materials
- Hydrogen embrittlement in Zircaloy-4 liner tube
- Mechanical behavior of automotive clearcoats

EDUCATION

- 2007 **Ph.D., Materials Science**
Oregon State University, Corvallis, OR, USA
Advisor: Dr. Jamie J. Kruzic
Thesis: "Fatigue of bulk metallic glasses: role of free volume."
- 2004 **M.S., Materials Science**
Oregon State University, Corvallis, OR, USA
Advisor: Professor Ralf Busch
Thesis: "Fatigue and fracture of $Zr_{41.25}Ti_{13.75}Ni_{10}Cu_{12.5}Be_{22.5}$ bulk metallic glass."
- 2001 **Engineer, Materials Engineering**
ENSMA, University of Poitiers, Poitiers, France
Honor Student

CONSULTING EXPERIENCE

Medical devices and implants

- Present Failure analysis consultant for Davis Law Offices, LLC, Springfield, IL
Failure analysis of IVC (inferior vena cava) filters
- Failure analysis consultant for Hartley & O'Brien, PLLC, Wheeling, WV
Failure analysis of IVC (inferior vena cava) filters
- Mechanical testing consultant for Ma & Estes Associates
Fracture toughness of pyrolytic carbon used in prosthetic heart valves
- Mechanical testing consultant for Edwards Lifesciences, Irvine, CA
Cyclic fatigue-crack propagation behavior in simulated physiological environments of 316L stainless steel used in prosthetic stents

RESEARCH EXPERIENCE

- 2007-Present **Post Doctoral Research Fellow**
Materials Sciences Division, Lawrence Berkeley National Laboratory &
University of California Berkeley
Berkeley, CA, USA
Advisor: Professor Robert O. Ritchie
- Investigator on the "Mechanical properties of advanced materials program" (former ceramics program) at LBNL led by Professor Robert O. Ritchie. Project funded by the Department of Energy under a \$3,000,000 grant over three years. Successfully designed, processed and characterized new bio-inspired hybrid materials based on the notion of hierarchical structure, combined with innovative processing, to develop high strength and toughness with lightweight ceramics. Results published in *Science*, and highlighted in *Nature*, *Materials Research Society Bulletin*, and *MIT Technology review*.
 - Developed and led collaboration with Professor William L. Johnson at the California Institute of Technology on the design and development of new bulk metallic glass composites with exceptional damage tolerance (fracture, fatigue). Results published in the *Proceedings of the National Academy of Sciences of the USA*, and highlighted on *MSNBC*, and *Discovery Channel*.

- Investigated the deformation and fracture behavior of biological materials, and biomaterials.
- Performed failure analysis on medical devices and implants.
- Designed and executed fracture mechanics tests including fracture toughness, stress-life fatigue, fatigue-crack propagation in different environments.
- In charge of the maintenance of the mechanical testing laboratory including both mechanical and servohydraulic testing equipment, e.g., Instron, MTS, and Bose.
- Proficient with characterization methods of materials including optical and electron microscopy, atomic force microscopy, micro- and nano-indentation, 3D synchrotron X-ray microtomography.
- Mentored and supervised undergraduate and graduate (MS and PhD) students.

2002-2007

Research Assistant

Oregon State University, Department of Mechanical Engineering
Corvallis, OR, USA

Advisor: Dr. Jamie J. Kruzic and Professor Ralf Busch

- Led investigation on the influence of free volume relaxation on the fatigue behavior of bulk metallic glasses. Research focused on the improvement of fatigue and fracture behavior by structural relaxation.
- Built and maintained a mechanical testing laboratory including both mechanical and servohydraulic testing machines.
- Executed fracture toughness, fatigue-crack propagation and stress-life fatigue experiments.
- Investigated the thermodynamics and kinetics of amorphous metals by scanning differential calorimetry.

Feb.2001-
Jul. 2001

Research Engineer

PSA Peugeot-Citroën, Department of Materials and Painting Processes
Vélizy-Villacoublay, France

Advisor: Dr. Catherine Verpy

PSA Peugeot Citroën is Europe's second largest carmaker with a 14.3% market share. In 2008, PSA Peugeot Citroën reported sales of passenger cars and light commercial vehicles to 3,260,000 units, representing a 5% share of the global market.

- Developed a mechanical model leading to a classification of the different clearcoats based on the manufacturer requirements. Model presented at the 2001 International Automotive Conference.
- Performed mechanical characterizations of polymers.
- Designed experiments to simulate mechanical and environmental constraints in conditions of use including resistance to scratches, gravels, chemical impurities, UV's...

Apr.1999-
Jun. 1999

Research Technician

Centre National de la Recherche Scientifique, Laboratory of Soil, Structure and
Materials Mechanics, École Centrale de Paris

Châtenay-Malabry, France

Advisor: Professor Mahmoud Habashi

The Centre National de la Recherche Scientifique (National Center for Scientific Research) is a government-funded research organization, under the administrative authority of France's Ministry of Research. The CNRS is the largest fundamental research organization in Europe.

The Ecole Centrale de Paris is considered as one of the leading engineering Grandes Écoles in the world today.

- Designed experiments to simulate mechanical and environmental constraints in operating conditions.

- Investigated the influence of hydrogen charging on the mechanical properties of Zircaloy-4 at ambient and high temperatures.
- Performed metallographic and failure analyses.

TEACHING EXPERIENCE

2002-2007 **Teaching Assistant**
Oregon State University, Department of Mechanical Engineering
Corvallis, OR, USA

- Guest lecturer for ME 484/584 “Fracture of Materials” (graduate) taught by J.J. Kruzic at Oregon State University - Spring 2006
- Guest lecturer for ENGR 322 “Mechanical Properties of Materials” (undergraduate) taught by J.J. Kruzic at Oregon State University, - Winter 2006
- ME 484/584 “Fracture of Materials” (graduate) - Spring 2004, 2005 and 2006
- ENGR 322 “Mechanical Properties of Materials” (undergraduate) - Winter 2004, 2005 and 2006
- ENGR 321 “Introduction to Materials Science” (undergraduate) - Winter and Fall 2004
- ME 480/580 “Materials Selection” (graduate) - Spring 2003

FELLOWSHIPS and AWARDS

2007 Rickert Engineering Fellowship
2007 John Naylor Research Fellowship
2006 Samuel H. and Violet F. Graf Research Fellowship
2006 ASM Student Night Award
2004 John Naylor Research Fellowship
2005 Nominated for the Boeing Fellowship
2001 Selected for the exchange program University of Poitiers – Oregon University System. Scholarship included full tuition waiver for the academic year 2001/2002.

PUBLICATIONS

Book Sections:

1. M.E. Launey and R.O. Ritchie. 2009 “Crack growth in noncrystalline solids”, *Encyclopedia of Tribology*, Q. J. Wang and Y.-W. Chung, Ed., Springer, New York.
2. R.O. Ritchie and M.E. Launey. 2009 “Crack growth in ductile and brittle solids”, *Encyclopedia of Tribology*, Q. J. Wang and Y.-W. Chung, Ed., Springer, New York.

Journals:

1. E. A. Zimmermann, M. E. Launey, R. O. Ritchie, “Mixed-mode crack-growth in human cortical bone” *Biomaterials*, in preparation
2. M. E. Launey, M. J. Buehler, R. O. Ritchie, “On the mechanistic origins of toughness in bone”, *Annual Review of Materials Research*, 2010, in review

3. M. E. Launey, E. Munch, D. H. Alsem, E. Saiz, A. P. Tomsia, R. O. Ritchie, "A novel biomimetic approach to the design of high performance ceramic/metal composites", *Journal of the Royal Society Interface*, 2009, in press
4. M. E. Launey, P.-Y. Chen, J. McKittrick, R. O. Ritchie, "Mechanistic aspects of fracture and R-curve behavior in elk antler bone" *Acta Biomaterialia*, 2009, in press
5. J. Franco, P. Hunger, M. E. Launey, E. Saiz, A. P. Tomsia, "Direct-write assembly of calcium phosphate scaffolds using a water-based hydrogel" *Acta Biomaterialia*, 2009, in press
6. E. A. Zimmermann, M. E. Launey, H. B. Barth, R. O. Ritchie, "Mixed-mode fracture of human cortical bone" *Biomaterials*, 2009, 30 (29) pp. 5877-5884
7. M. E. Launey, D. C. Hofmann, J.-Y. Suh, H. Kozachkov, W. L. Johnson, R. O. Ritchie, "Fracture toughness and crack-resistance curve behavior in metallic glass-matrix composites" *Applied Physics Letters*, 2009, 94 art. 241910
8. S. Bechtle, M. Kumar, B. P. Somerday, M. E. Launey, R. O. Ritchie, "Grain-boundary engineering markedly reduces susceptibility to intergranular hydrogen embrittlement in metallic materials" *Acta Materialia*, 2009, 57 (14) pp. 4148-4157
9. M. Liu, R. S. Vallery, D. W. Gidley, M. E. Launey, J. J. Kruzic, "Assessment of the fatigue transformation zone in bulk metallic glasses using positron annihilation spectroscopy", *Journal of Applied Physics*, 2009, 105 art. 093501
10. M. E. Launey, E. Munch, D. H. Alsem, H. B. Barth, E. Saiz, A. P. Tomsia, R. O. Ritchie, "Designing highly toughened hybrid composites through nature-inspired hierarchical complexity", *Acta Materialia*, 2009, 57 (10) pp. 2919-2932
11. M. E. Launey, D. C. Hofmann, W. L. Johnson, R. O. Ritchie, "Solution to the problem of the poor cyclic fatigue resistance of bulk metallic glasses" *Proceedings of the National Academy of Sciences of the United States of America*, 2009, 106 (13) pp. 4986-4991
12. M. E. Launey, R. O. Ritchie, "On the fracture toughness of advanced materials", *Advanced Materials*, 2009, 21 (20) pp. 2103-2110
13. E. Munch, M. E. Launey, D. H. Alsem, E. Saiz, A. P. Tomsia, R. O. Ritchie, "Tough, bio-inspired hybrid materials", *Science*, 2008, 322 (5907) pp.1516-1520
14. M. E. Launey, R. Busch, J. J. Kruzic, "Effect of free volume changes and residual stresses on the fatigue and fracture behavior of a Zr-Ti-Ni-Cu-Be bulk metallic glass", *Acta Materialia*, 2008, 56 (3) pp.500-510
15. R. S. Vallery, M. Liu, D. W. Gidley, M. E. Launey, J. J. Kruzic, "Characterization of fatigue induced free volume changes in a bulk metallic glass using positron annihilation spectroscopy", *Applied Physics Letters*, 2007, 91 art. 261908
16. M.E. Launey, J.J. Kruzic, C. Li and R. Busch, "Quantification of free volume differences in a $Zr_{44}Ti_{11}Ni_{10}Cu_{10}Be_{25}$ bulk amorphous alloy", *Applied Physics Letters*, 2007, 91 art. 051913
17. M.E. Launey, R. Busch and J.J. Kruzic, "Influence of structural relaxation on the fatigue behavior of a $Zr_{41.25}Ti_{13.75}Ni_{10}Cu_{12.5}Be_{22.5}$ bulk amorphous alloy", *Scripta Materialia*, 2006, 54 (3) pp.483-487

Conference Proceedings:

1. J.J. Kruzic, M.E. Launey and R. Busch, "Fatigue of bulk metallic glasses: role of free volume", in *Bulk Metallic Glasses*, P.K. Liaw and R.A. Buchanan, eds., TMS, Warrendal, PA, 2006, pp. 45-50.

Research Highlights:

1. "Materials science: Tough shell secrets", *Nature*, 2008, 456(7223) p.678
2. "Ceramics that won't shatter", *MIT Technology Review*, December 2008
3. "Tough ceramic mimics mother of pearl", *MRS Bulletin*, 2009, 34 p.77
4. "Super-tough metallic glass", *ChemMatters*, American Ceramic Society, to appear in October 2009 issue
5. "Lightweight metallic glass is strong as steel", featured story on *MSNBC* and *Discovery Channel*

PRESENTATIONS

1. M. E. Launey, D. C. Hofmann, W. L. Johnson, and R. O. Ritchie, "Fracture and Fatigue of Zr- and Ti-based Metallic Glass *in-situ* Matrix Composites", 2010 TMS Annual Meeting, Seattle, WA, February 2010. **Invited presentation.**
2. D. C. Hofmann, M. E. Launey, R. O. Ritchie, and W. L. Johnson, "Bulk Metallic Glass Composites: A New High-Performance Structural Material", 2010 TMS Annual Meeting, Seattle, WA, February 2010.
3. J. J. Kruzic, S. L. Philo, and M. E. Launey, "Mechanisms of Fatigue Crack Growth in Zr-based Bulk Metallic Glasses", 2010 TMS Annual Meeting, Seattle, WA, February 2010.
4. H. B. Barth, A. MacDowell, M. E. Launey, and R. O. Ritchie, "Looking at the Effects of Radiation Doses on the Fracture Toughness of Human Cortical Bone", 2010 TMS Annual Meeting, Seattle, WA, February 2010.
5. P.-Y. Chen, M. E. Launey, R. M. Kulin, K. S. Vecchio, R. O. Ritchie, and J. McKittrick, "Toughening Mechanisms in Antler: A New Light on Bone Fracture", Third International Conference on Mechanics of Biomaterials & Tissues, Clearwater Beach, FL, December 2009.
6. P.-Y. Chen, J. M. Curiel, R. M. Kulin, M. E. Launey, J. McKittrick, K. S. Vecchio, R. O. Ritchie "Comparative Study of the Structure and Mechanical Properties of Antler and Bone", 8th Pacific Rim Conference on Ceramic and Glass Technology, Vancouver, BC, June 2009. **Invited presentation.**
7. M. E. Launey, E. Munch, D. H. Alsem, E. Saiz, A. P. Tomsia, and R. O. Ritchie "Nature-Inspired Design of Highly Toughened Materials", 2009 MRS Spring Meeting, San Francisco, CA, April 2009. **Invited presentation.**
8. M. E. Launey, D. C. Hofmann, J.-Y. Suh, W. L. Johnson, and R. O. Ritchie, "Highly-Toughened Metallic Glass In-Situ Matrix Composites", 2009 TMS Annual Meeting, San Francisco, CA, February 2009.

9. R. O. Ritchie, E. Munch, M. E. Launey, D. H. Alsem, E. Saiz, and A. P. Tomsia, "Nature-Inspired Structural Materials", 2008 MRS Fall Meeting, Boston, MA, December 2008. **Invited presentation.**
10. R. O. Ritchie, D. H. Alsem, M. E. Launey, E. Munch, E. Saiz, and A. P. Tomsia, "Nature-Inspired Hybrid Structural Materials", 7th International Workshops on Interfaces, R.M. Cannon Memorial Workshop, New Materials via Interfacial Control, Santiago, Spain, June 2008. **Invited presentation.**
11. D. H. Alsem, M. E. Launey, E. Munch, E. Saiz, A. P. Tomsia and Robert O. Ritchie, "Nature-Inspired Hybrid Structural Materials", 2008 MRS Spring Meeting, San Francisco, CA, March 2008. **Invited presentation.**
12. M. E. Launey, R. S. Vallery, M. Liu, D. W. Gidley, R. Busch, J. J. Kruzic, "Effect of free volume changes and residual stresses on the fatigue and fracture behavior of a Zr-Ti-Ni-Cu-Be bulk metallic glass", 2007 MRS Fall Meeting, Boston, MA, November 2007.
13. M. E. Launey, J. J. Kruzic, R. Busch, "Effect of free volume changes on the fatigue and fracture behavior of a Zr-Ti-Ni-Cu-Be bulk metallic glass", 2007 TMS Annual Meeting, Orlando, FL, February 2007.
14. M.E. Launey, "Fatigue of bulk metallic glasses: role of free volume", Meeting of the Oregon Chapter of ASM, Student Night, Portland, OR, April 2006. **Invited presentation.**
15. J.J. Kruzic, M.E. Launey and R. Busch, "Fatigue of bulk metallic glasses: role of free volume", 2006 TMS Annual Meeting, San Antonio, TX, March 2006.
16. M.E. Launey, "Influence of structural relaxation on the fatigue behavior of a $Zr_{41.25}Ti_{13.75}Ni_{10}Cu_{12.5}Be_{22.5}$ bulk amorphous alloy", Kelley Engineering Grand Opening, Oregon State University, Corvallis, OR, October 2005. **Invited presentation.**

PATENTS

1. R.O. Ritchie, A.P. Tomsia, E. Saiz, M.E. Launey, D.H. Alsem. E. Munch, "High toughness Nature-inspired hybrid structural ceramic materials, utilizing a lubricant phase", 2009, in process

PROFESSIONAL AFFILIATIONS

Member of The Minerals, Metals and Materials Society (TMS)

Member of The Materials Research Society (MRS)

TECHNICAL REVIEWER

Acta Materialia (2007-present)

Scripta Materialia (2007-present)

Metallurgical and Materials Transactions A (2007-present)

Journal of Materials Science (2008-present)

International Journal of Fatigue (2008-present)

International Journal of Materials Research – Zeitschrift für Metallkunde (2009-present)

National Institutes of Health (2009-present)