

Kurt J. Koester

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OBJECTIVE:

To obtain a position that allows me to use my skills and knowledge in materials science to conduct research and develop new products and technologies.

EDUCATION:

2003-2007 University of California, Berkeley Berkeley, CA

Doctor of Philosophy, Engineering, Materials Science and Engineering
Minors: Bioengineering and Business Administration
Master of Engineering, Materials Science and Engineering
Management of Technology Certificate, Haas School of Business

2001-2003 University of Minnesota, Twin Cities Minneapolis, MN

Bachelor Materials, Materials Science and Engineering

1999-2001 Saint Cloud State University Saint Cloud, MN

WORK EXPERIENCE:

2008-Present **Biological Factors and The Fracture of Mineralized Tissues**
Lawrence Berkeley National Laboratory Berkeley, CA
Materials Sciences Division, Materials Science Postdoctoral Fellow

- Principal Investigator: Senior Faculty Scientist Robert O. Ritchie
- Designed, executed, and published original studies:
 - »Influence of age on the transverse fracture resistance of human cortical bone
 - »Dimensionality of fracture in human cortical bone
 - »Examination of using indentation toughness measurements to study bone
 - »Mechanisms, what fracture mechanics offers biologists
 - »Bone mineral density measurement comparisons, technique advantages and disadvantages
 - »Local bone mineral density distribution and crack trajectory
 - »Impact of pharmaceutical therapies for osteoporosis on the mechanical properties of canine bone
 - »Mechanistic origins of the fracture resistance of mice and rats
 - »Effect of hydration on the crack-growth resistance (R-curve) of human dentin
- Participated in multidisciplinary collaborative research projects.
- Assisted in supervising and supporting five graduate students conducting bone research.

Microstructural Origins of Mechanical Properties in Engineering and Biological Materials

2003-2007

University of California, Berkeley

Berkeley, CA

Materials Science and Engineering Department, Graduate Student Researcher

- Research advisor: Professor Robert O. Ritchie
- Worked with diverse materials:
 - » Organic/inorganic composites, ceramic/metallic composites, polymers, ceramics, bone substitute materials, bone, dentin, cartilage, and tendons
- Assembled framework for understanding these materials.
 - » Mechanical properties and the microstructural features dictating material behavior
 - » Focused on R-curve analysis, fracture toughness, and toughening mechanisms.
- Applied framework to multiple materials and biological tissues.
- Published results and presented at professional meetings.
- Trained 14 colleagues to use equipment and techniques to conduct their research.
- Simultaneously managed and conducted six collaborative research projects.
 - » Logistics, experimental design, meetings, fabrication, testing, and analysis
 - » Integrated results from different researchers and locations
- Experienced working with multidisciplinary teams.
 - » Biomedical engineers, materials scientists, mechanical engineers, molecular biologists, orthopedists, physicists, rheumatologists, and surgeons
- Performed significant experiments and measurements for the first time:
 - » Transverse orientation R-curves in human bone
 - » Nonlinear elastic fracture mechanics analysis in the transverse direction of human bone
 - » Physiologically pertinent short crack R-curves in human bone and dentin
 - » *In situ* crack growth in human bone and dentin with real-time imaging
 - » Identification of new extrinsic toughening mechanisms in bone
 - » Fracture toughness of on rat femurs for drug evaluation
 - » Application of nonlinear elastic fracture mechanics to rat and mouse femurs
 - » *In situ* crack growth in rat bone with simultaneous imaging

Mechanical Behavior of Engineering Materials Course

Fall 2005

University of California, Berkeley

Berkeley, CA

Materials Science and Engineering Department, Graduate Student Instructor

Assisted in teaching an upper division undergraduate course on the fracture and deformation of materials.

Polymer Processing, Morphology, and Mechanical Properties

2001-2003

University of Minnesota, Twin Cities

Minneapolis, MN

Chemical Engineering and Materials Science Department, Undergraduate Researcher

- Research advisors: Professors Robert F. Cook and Christopher W. Macosko
- Conducted and managed a self directed project with Goodyear Chemical to develop an injection moldable composite of styrene-butadiene rubber and polypropylene for “soft touch” applications.
- Published results of this work and presented at the 2003 IPRIME conference.
- Examined the influence of processing and composition on the morphology of polystyrene/polyethylene oxide composites.
- Developed techniques for the detection of the onset of cocontinuity in polymer blends.

Sol-Gel Modified Quartz Crystal Microbalance

2000-2001

Saint Cloud State University
Chemistry Department, Undergraduate Researcher

Saint Cloud, MN

- Research advisor: Professor Donald Neu
- Initiated research to create a sensor, utilizing a sol-gel modified quartz crystal microbalance, for detecting organic contaminants in water.
- Advanced the project through its early stages and presented the preliminary results at the Student Research Colloquium at St. Cloud State University and at the 222nd annual conference of the American Chemical Society.

STRUCTURE VS. PROPERTIES ANALYSIS EXPERTISE:

Crack-Growth Resistance Curves: Utilized an array of techniques to accurately measure R-curves *in situ* and *ex situ*.

Driving force	Linear elastic fracture mechanics Crack deflection and twist mechanics Nonlinear elastic fracture mechanics
Crack length	Visual light microscopy Scanning electron microscopy Compliance measurements

***In situ* Microscopy of Crack Growth:** Real-time study of the evolution of the crack profile to characterize the salient intrinsic and extrinsic toughening mechanisms and their origins.

Microscopy	Scanning electron microscope Environmental scanning electron microscope Quantitative backscattered electron imaging Visual light microscope
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Mechanical Testing: Characterized pertinent mechanical properties using a variety of techniques.

Depth sensing nano-/micro- indentation	Modulus	Hardness
Tension, compression, bending	Stress-strain behavior Yield strength Strain to failure Fracture toughness Creep	Modulus Ultimate strength Work to fracture R-curve Fatigue

X-Ray Tomography: Imaged crack profiles in bone in three dimensions to characterize the effect of microstructural features on toughening mechanisms and, thereby, fracture resistance.

Microstructural Characterization: Utilized microscopy techniques to characterize the microstructures of diverse materials and tissues.

Imaging	Electron microscopy Quantitative backscattered electron imaging Atomic force microscopy Visual light microscopy X-ray computed tomography
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Polymer Processing: Studied the flow characteristics of polymer blends to optimize processing.

Rheology	Capillary rheology Dynamic mechanical analysis
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BUSINESS COURSE EXPERIENCE:

2003-2007 University of California, Berkeley Berkeley, CA
Haas School of Business, Management of Technology Program

- Courses to complete the Master of Engineering degree and the Management of Technology program.
- Worked in cooperative teams of engineers and business students.
 - »Collaboration with people who have different backgrounds and skill sets.
 - »Experience crossing domains between business and engineering.
- Introduced to a host of technology driven industries
- Learned the crucial importance of having a fundamental understanding of the technology that propels a company
- Courses taken:
 - »Introduction to the Management of Technology
 - »International Trade and Competition in High-Technology
 - »Services Science
 - »Business of Biotechnology
 - »Entrepreneurship in Biotechnology

EQUIPMENT AND INSTRUMENT EXPERIENCE:

Machining	Vertical/horizontal band saws	End mill
Sample fabrication (Polymer processing)	Micro-batch mixer Twin-screw extruder Injection molder	Batch mixer Hot press
Sample preparation	High-speed saw Polishing wheels Microtome	Low-speed saw Razor micronotching
Rheology	Capillary rheometer	Dynamic mechanical analysis
Mechanical testing	Microhardness indenter Servohydraulic test frames (MTS, with analog and digital controllers)	Depth-sensing indentation (nano and micro) Enduratec test frames (tension/compression/torsion)
Imaging	Visual light microscope Environmental scanning electron microscope	Scanning electron microscope Atomic force microscope X-ray tomography
<i>In Situ</i> testing	Manual test stage	Digital test stage

COMPUTER PROGRAMS:

Microsoft Office (Word, Excel, Powerpoint, Outlook)	Adobe (Illustrator, InDesign, Photoshop, Acrobat, Premiere)
Mathematica	Origin
ImageJ	Endnote

Labview	Octopus
Amira	Deben Microtest

HONORS AND ACHIEVEMENTS:

University of Minnesota, Twin Cities

- Dean's list for the Institute of Technology from 2001-2003
- Induction into the engineering honor society Tau Beta Pi in 2002

Saint Cloud State University

- Competed on the swim team
- Student athlete honor roll from 1999-2001
- Chemistry Departmental Scholarship 2000
- Sorenson Chemistry Scholarship in 2000

CITIZENSHIP:

United States Citizen

PUBLISHED WORK:

- [1] Galloway, JA, **Koester, KJ**, Paasch, BJ, Macosko, CW. Effect of sample size on solvent extraction for detecting cocontinuity in polymer blends. *Polymer* 2004;45:423-28.
- [2] Cook, R, **Koester, K**, Macosko, C, Ajbani, M. Rheological and mechanical behavior of blends of styrene-butadiene rubber with polypropylene. *Polym Eng Sci* 2005;45:1487-97.
- [3] Yao, W, Cheng, Z, **Koester, KJ**, Ager, JW, Balooch, M, Pham, A, Chefo, S, Busse, C, Ritchie, RO, Lane, NE. The degree of bone mineralization is maintained with single intravenous bisphosphonates in aged estrogen-deficient rats and is a strong predictor of bone strength. *Bone* 2007;41:804-12.
- [4] **Koester, KJ**, Ager III, JW, Ritchie, RO. The effect of aging on crack-growth resistance and toughening mechanisms in human dentin. *Biomaterials* 2008;29:1318-28.
- [5] **Koester, KJ**, Ager III, JW, Ritchie, RO. Aging and fracture of human cortical bone and tooth dentin. *JOM* 2008;60:33-38.
- [6] Thomson, KE, Jiang, D, Lemberg, JA, **Koester, KJ**, Ritchie, RO, Mukherjee, AK. In-situ bend testing of niobium-reinforced alumina nanocomposites with and without single-walled carbon nanotubes. *Mater Sci Eng A* 2008; doi:10.1016/j.msea.2007.05.123.
- [7] **Koester, KJ**, Ager III, JW, Ritchie, RO. The true toughness of human cortical bone measured with realistically short cracks. *Nat Mater* 2008;doi:10.1038/nmat2221.
- [8] Ritchie, RO, **Koester, KJ**, Ionova, S, Yao, W, Lane, NE, Ager III, JW. Measurement of the toughness of bone: A tutorial with special reference to small animal studies. *Bone* 2008;doi: 10.1016/j.bone.2008.04.027.
- [9] Kim, DK, **Koester, KJ**, Ritchie, RO. Can the fracture toughness of bone be assessed by indentation? *J Mech Behav Biomed Mater* 2008; in review.
- [10] Yao, W, Cheng, Z, **Koester, KJ**, Zimmerman, EA, Busse, C, Ritchie, RO, Lane, NE. Prolonged treatments with anti-resorptive agents and PTH have different effects on bone strength and the degree of mineralization in estrogen deficient osteoporosis in aged female rats. 2008; in preparation.
- [11] **Koester, KJ**, Bechtle, S, Ager III, JW, Ritchie, RO. The dimensionality of fracture in human cortical bone. 2008; in preparation.