Department Focuses on Micro/Nano, Energy and Environment, Bioengineering

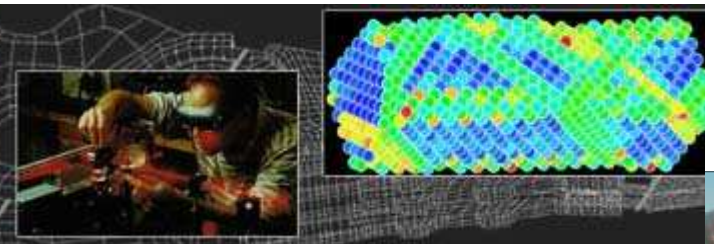
The Department of Mechanical Engineering at the University of Colorado at Boulder focuses on advancing research and education in the areas of micro and nano systems, energy and environment, and bioengineering. The department has 26 faculty and four interdisciplinary research centers, including two NSF-sponsored centers.

In 2004-05, the department established a new centralized Nanoscale Fabrication and Characterization Laboratory, completed a cleanroom for microsystems research, and continued its NIH training program in cardiovascular bioengineering, which combines engineering and clinical expertise to develop new tools for cardiovascular diagnosis and treatment.

Departmental research activities in micro and nano systems include design and reliability of MEMS, nanosystems, mechanical properties of nanowires, nanomaterial processing, nanocomposites, disk drive shock analysis, microporous membranes, polymer derived ceramics, active materials and structures, multi-scale computational fluids modeling, and MEMS/electronics packaging.

Research in energy and environment includes flame treatment of polymer films, microgravity combustion of metals, wildfire behavior, urban air quality modeling, indoor air pollution, and theoretical/ computational fluid dynamics.

Bioengineering research includes optical biopsy of prostate cancer, shape memory polymers/alloys, cardiovascular fluid/ biomechanics, MEMS-based biosensing, ultrasound imaging, device design, nanoparticle diagnostics, and metallic/polymer biomaterials.



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Mechanical Engineering
University of Colorado *at* Boulder
College of Engineering & Applied Science

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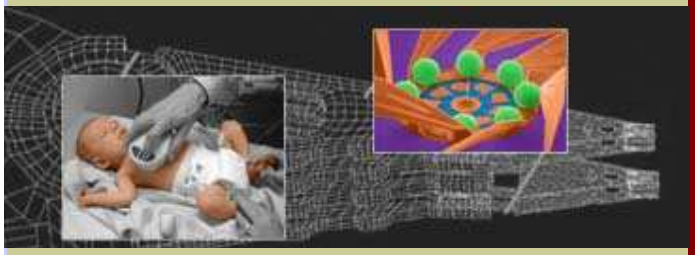

An AFM was used to carve the University of Colorado's mascot - the buffalo - onto a CD surface. The true size is about 1.5 microns by 1.5 microns. The diameter of a human hair is about 70 microns –a herd of about 150 of these buffaloes would be needed to surround a human hair!

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The Department of Mechanical Engineering at the University of Colorado at Boulder provides a stimulating environment for graduate study, supported by a wide variety of exciting, wellfunded research projects addressing modern topics in micro/nanotechnology, energy and environmental engineering, and biomedical engineering. Many of these research efforts are pursued by faculty clusters in four interdisciplinary research centers, including two NSF-sponsored centers and an NIH training program. Research projects harness state-of-the-art experimental, theoretical, and computational approaches to train students and advance the frontiers of technology, while also advancing fundamentals in the underlying disciplines of fluid and solid mechanics, thermal engineering, materials engineering, design, and computational engineering.

Graduate students enjoy access to state-of-the-art facilities, work closely with vibrant, highly-qualified faculty, and benefit from strong interactions with industry. Many take advantage of opportunities to work on year-long industry-sponsored design projects facilitated by our Industry/University Cooperative Projects Center. Close partnerships with national research laboratories in the Boulder area further strengthen our graduate program. Nearly all of our senior faculty are fellows in major professional societies, and three received the highest national awards given by the American Society of Mechanical Engineers.

- $4 Million Sponsored Research Awards
- 26 Faculty
- 133 Graduate and 640 Undergraduate Students
- Average Quantitative GRE Score of 750

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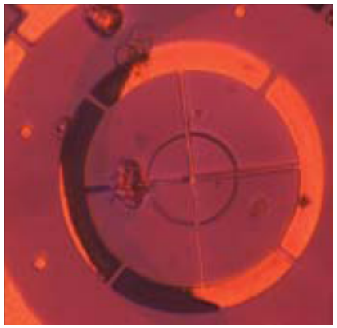
Interdisciplinary Research Centers Provide Graduate Student Opportunities

Center for Advanced Manufacturing and Packaging of Microwave, Optical, and Digital Electronics, an NSF I/UCRC, provides a knowledge base for packaging and integration of very high-speed microwave, optical, and digital electronics. The center is focused on investigating the reliability of MEMS and the design of application-specific MEMS devices.

Joint Center for Combustion and Environmental Research studies fundamental problems relating to the field of combustion and environmental protection. Experimental, analytical, and computational research methods are used to study aspects of combustion phenomena and air quality.

Center for Membrane Applied Science and Technology, an NSF multi-university center with the University of Cincinnati, researches membrane-based separations and synthetic membrane formation and characterization. These projects have generated over $3 million in follow-on funding for the mechanical engineering and chemical/biological engineering-led center.

MicroElectronic Devices in Cardiovascular Applications promotes study and utilization of microdevices in cardiovascular applications. Children's Hospital



CU Research Team Licenses Technology for Cardiac Screening

A research team led by CU mechanical engineering Professor Roop Mahajan has developed a diagnostic decision support system incorporating an artificial neural network for classification of infant heart murmurs. The technology was recently licensed to a start-up company to help meet the needs of pediatric cardiologists. The researchers worked with clinicians at CU's Health Sciences Center and Children's Hospital to develop the system, which enables a doctor or nurse to quickly and accurately distinguish innocent from serious heart murmurs with a digital stethoscope. The early detection of malignant murmurs and follow-up intervention has the potential to save lives and prevent severe health problems that may arise if underlying problems are left untreated.

Chris, Yakacki, a doctoral student in mechanical engineering, is helping to shape our medical future using shape memory materials.
"I am researching how to use stereo lithography to hotopolymerize intricate, shape memory cardiovascular devices. I enjoy the research because it involves so many areas of engineering — there is design in the stereo lithography, material science and chemical engineering in the photopolymerization, thermodynamics and heat transfer in the shape memory effect, and biomedical engineering to make sure the device has a purpose in the medical industry," he says.
"It is also rewarding to know that my research can advance the field of biomedical engineering and may be used to save lives in the future."