COVER SHEET FOR GRANT PROPOSALS

State Board of Education

SBOE PROPOSAL NUMBER: (to be assigned by SBOE)	AMOUNT REQUESTED: $50,000
TITLE OF PROPOSED PROJECT: Nanospring coatings for the promotion of bone growth on prostheses	
SPECIFIC PROJECT FOCUS: Biomedical devices and artificial bone growth	
PROJECT START DATE: July 1, 2011	PROJECT END DATE: June 30, 2012
NAME OF INSTITUTION: University of Idaho	DEPARTMENT: Biological Sciences and Physics
ADDRESS: E&P Bldg, P.O. Box 440903, University of Idaho, Moscow, ID	

	E-MAIL ADDRESS: Gustavo@uidaho.com dmcilroy@uidaho.edu	PI PHONE NUMBER: 208-885-6079 208-885-7822

	NAME:	TITLE:	SIGNATURE:
PROJECT DIRECTOR	David McIlroy	Professor,	[signature]
CO-PRINCIPAL INVESTIGATOR	Gustavo Arrizabalaga	Associate Professor	[signature]
CO-PRINCIPAL INVESTIGATOR			
CO-PRINCIPAL INVESTIGATOR			

	NAME:	SIGNATURE:
Authorized Organizational Representative	**Polly J Knutson, Director** **Office of Sponsored Programs** **University of Idaho** SK	Polly Knutson

1. Executive Summary:

Prostheses are a critical area of health care in the Idaho and the United States, particularly for the elderly and soldiers injured in Iraq and Afghanistan. The primary cause for failure of prosthesis is poor interface between the implant and the bone to which it is to be attached. Researchers at the University of Idaho have developed a nanospring-based coating, which, in initial studies, enhances cell proliferation and bone formation. This work has already attracted the interest of companies with major research thrust in dental implants and prostheses. Thus, gap funding provided by HERC would allow us to flesh out the promising preliminary findings to a point where private investment can be obtained. An added economic benefit of our work is that a local company, GoNano Technologies, has the licensing rights to produce and sell the nanosprings that are central to our work. Thus development of a nanospring coating for prostheses will expand their sales and production, which will create new jobs in Idaho.

2. Project Objectives and Amount Requested:

The primary objective of this project is to extend the preliminary studies of cell proliferation and bone formation on nanospring coatings to the point where external funding can be obtained from the private sector or the federal government. <u>The final product of our work will be a detailed and reliable method for the growth of bone cells and mature bone tissue in culture as well as in the surface of prostheses material.</u> We are requesting $50,000 for the project.

3. Idaho Public Institution Involved in Project:

University of Idaho, Moscow, ID.

4. Faculty Directing the Project:

Dr. Gustavo Arrizabalaga and Dr. David McIlroy.

5. Alignment of Project Objective with University of Idaho's Priorities:

The University of Idaho made a five-year commitment to the Biological Applications of Nanotechnology Program (BANTech). The goal of the program was to develop core competency in the field of bionanotechnology. Furthermore, biological sciences are, and will continue to be, a major area of interest to the University of Idaho and is in line with their land grant mission.

6. Evidence of Economic Impact:

In terms of economic development for Idaho nanospring-based technology has already made an impact with the formation of GoNano Technologies, Inc., of Moscow, in 2007. Since its inception, GoNano has grown from four employees to nine employees, where the average salary is ~$55,000. The proposed project will help spur further demand for nanosprings, which will translate into more sales for GoNano and further growth of their operation. Thus, the effects this project on the economy of Idaho will be immediate!

7. Establishment of Partnership with Private Sector:

A secondary objective of our work is to establish a commercial relationship with a corporate partner with the resources to take the project from academia to market. The cost for commercialization of a coating prosthetics requires resources that are beyond the capabilities of academia. With this objective in mind the principal investigators have approached 3M with their preliminary results and have been encouraged by the interest expressed by company representatives.

8. Market Opportunity:

The market for prostheses is enormous, and BCC Research projects that the U.S. prosthesis market will experience a growth of 38% this year alone. Displayed in Figure 1 is the market trend for prostheses by BCC Research. The U.S. market was approximately $9 billion in 2004 and is expected to grow to $17 billion by the end of this year!

The biggest challenge facing the prostheses market, is implant failure. Implants are typically located in the body where there are high loads and use, such as joint replacements and dental implants. Failures most commonly occur at the bone-prosthesis interface, i.e. where the replacement adheres to the bone. Therefore, there is a need for new techniques and materials that enhance the interaction between the insert and the bone. Our contribution to solving this problem is the discovery that nanospring coatings promote bone formation. Thus coating prosthetic implants with nanosprings would result in a living bone interface with the prosthesis that would significantly reduce, or eliminate, implant failure.

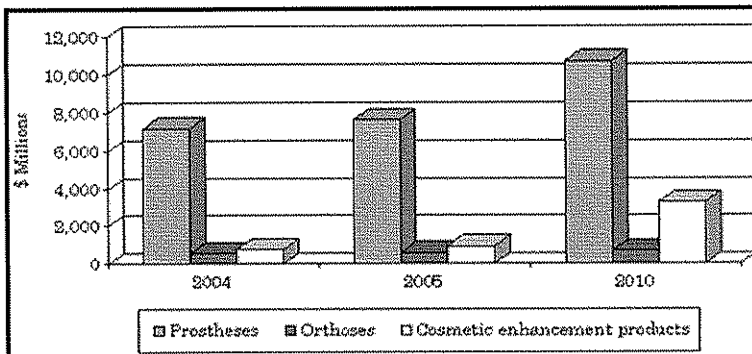

Figure 1. Prosthesis market from 2004 projected to 2010. Report code: HLCD 45A. Published: October 2005, Analyst Andrew McWilliams. From BCC Research.

The major application of our nanospring based technology as we have established it so far is as a coating in prostheses and other implanted material that needs to contact bone tissue. Other applications include growing bone in vitro that can then be incorporated into prostheses or be directly implanted into humans or animals, and using our enhanced bone growth system for laboratory based studies and screens.

The primary competition to nanospring coatings for prostheses is adhesives. Companies, such as 3M, are actively working to develop stronger biocompatible adhesives. The fundamental flaw with this approach is that adhesives cannot promote bone formation and therefore will always be subject to their current limitations. Better adhesives will only reduce failures, but will never lead to better prosthesis technology. The barrier to nanospring-based prosthesis coatings is time and money. The timeline for taking a new technology for prostheses from the laboratory is typically 10 years. This is primarily due to the time it takes to obtain approval from the Food and Drug Administration. The requested funds will help us to move our technology into the veterinary industry from which it can quickly be implemented, usually two years, and generate the funds and industry support required for FDA approval.

9. The Technology: Nanospring Coatings for Prosthesis Applications:

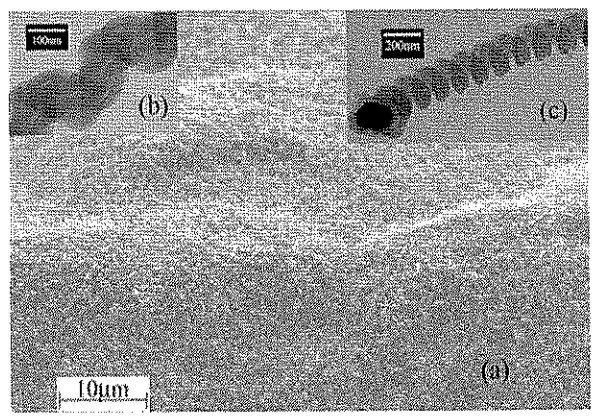

Figure 2. (a) TEM image of a mat of silica nanosprings. Insets (a and b) are close up images of silica nanosprings

Description of the technology and its current state: Silica nanosprings were developed at the University of Idaho in Prof. David McIlroy's laboratory. They are formed from silica (glass) and can be manufactured as a coating on virtually any surface one might wish to use. This includes metals, ceramics, aluminum foil, and some high temperature plastics. They form an extremely strong bond to the surface upon which they are manufactured. Consequently, they cannot be readily removed except with mechanical abrasion. Transmission electron microscope (TEM) images of individual nanosprings are presented in Figure 2 as an example of a nanospring coating.

The overall network established by nanosprings (Fig. 3A) is morphologically similar to what is formed by connective collagen networks found in bone (Fig 3B). The remarkable similarity between these structures led us to hypothesize that nanospring films would be an ideal scaffold upon which bone cells could grow into mature bone tissue. One of the features that make nanosprings an ideal surface to grow cells in contrast to conventional nanomaterials is the increased surface area provided by the turns of the springs. Furthermore, silica, the material that nanosprings are comprised of is inert and bio-friendly and thus unlikely to kill cells or be rejected by the immune system.

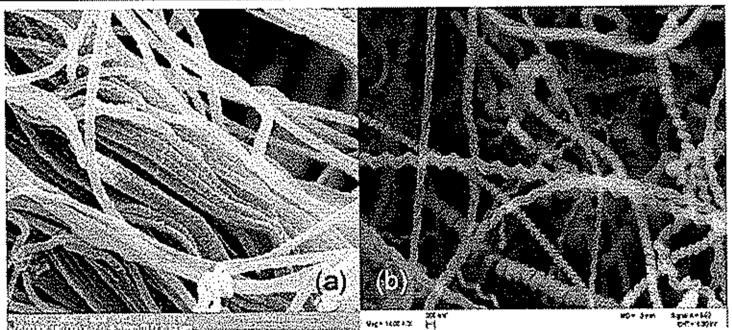

Figure 3. Field Emission Scanning Electron Microscope image of (a) knee joint collagen and (b) silica nanosprings. Both images at 14000 X.

As a first step in our proof on concept studies we determined that glass slides covered with bare and coated nanowires could resist heat sterilization. This step was necessary since culturing cells requires extremely sterile conditions but also because if nanosprings are to used on prostheses that are inserted into humans or animals they needs to survive sterilization. Autoclaving the nanowires proved to be a trivial hurdle and we found that nanospring coated glass discs are more user friendly than traditional substrates for bone culturing. Example of a variety of nanospring coated bone cell culture discs are displayed in Figure 4(a) before autoclaving, (b) after autoclaving in hermetically sealed packaging and (c) in test wells for bone cell culturing.

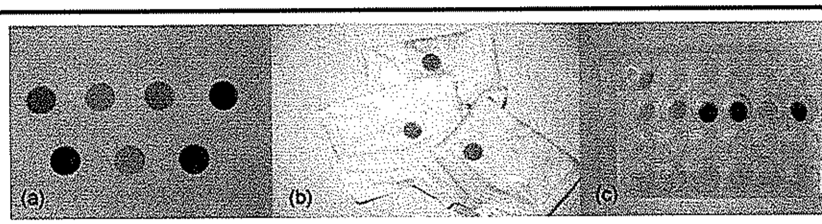

Figure 4. Prepared culture discs with nanospring coatings (a), culture discs after being sterilized in hermetically sealed pouches (b), and autoclaved coated culture discs in tissue culture well plates ready for cell growth (c).

For our initial bone cell proliferation tests, equal number of human osteoblasts (bone forming cells), were added to autoclaved glass discs that were either bare or covered with bare nanosprings or coated nanosprings (coatings were: gold, zinc oxide, titanium oxide or combination of thereof). As to control for the effect of the metal coats by themselves we also grew osteoblasts on glass slides covered with the coatings alone. All cells culture samples were grown in osteoblast growth medium (Lonza Scientific). Cell proliferation was monitored every other day by counting the number of cells in each sample using alamar-blue dye. In this manner we determined that not only would bone cells proliferate on nanospring coated culture discs, but that proliferation of cells was enhanced by nanosprings (Fig. 5A). After 5 days of growth on titania, gold and zinc oxide coated disc without nanosprings we see approximately 200 osteoblasts (data from 3 independent experiments). By contrast we see more than a tripling in the number of cells when nanosprings are added to the surface. We have since demonstrated that the bone cells proliferate into the nanospring coating forming a three-dimensional cell structure, and that the cells are depositing calcium (Fig. 5 B and C). The presence of calcium demonstrates that the cells are forming bone, as opposed to simply enhancing cell proliferation without bone formation.

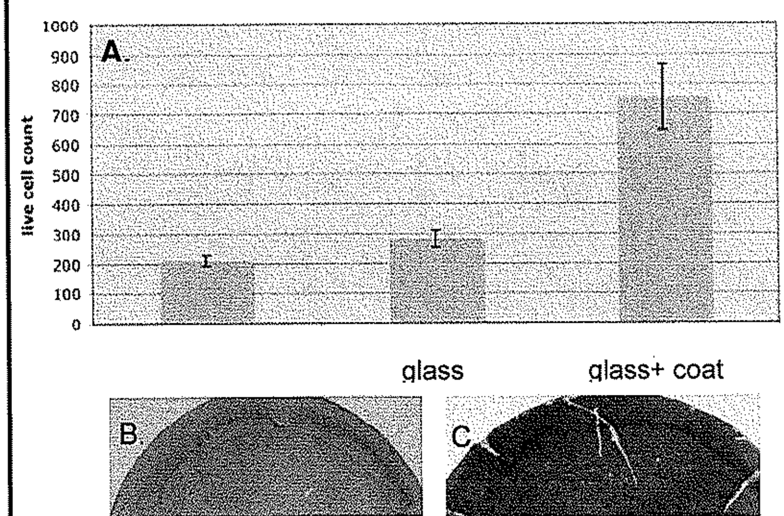

Figure 5. A. Average number of cells after 5 days of growth on either bare glass, glass with metal coating or glass with nanosprings and coating. Coating in this experiment consisted of titania, zinc oxide and gold nanoparticles. B and C. Staining for calcium deposits in bare glass (B) or glass covered with coated nanosprings. In staining assay the darker the tissue the more calcium deposited.

Presently, we have shown that cells needed for bone growth: a) are not killed by the presence of nanosprings, b) grow at a faster rate on nanospring that in bare surfaces, c) proliferate in various directions to cover all the surfaces provided by the nanosprings, d) deposit calcium into the extracellular matrix. <u>Thus, the current status of the technology is past the proof of concept stage and has entered the optimization period.</u> In order to commercialize the technology further studies are needed. In particular, identification of the optimal coatings on the nanosprings for bone cell proliferation and bone formation is needed. Furthermore, mechanical testing of the artificial bone grown in the nanosprings will enhance the marketing of the technology. Within this context gap funding will aid in the last steps of transitioning our discovery from academia to industry.

Intellectual Property Status and Contribution of the Technology to Market Needs: Patents of the nanospring growth process are in prosecution and should be issued in the next six to twelve month, and a license has been issued to GoNano Technologies, Inc., Moscow, ID. The university's Intellectual Property office has begun preparing IP protection on the use of nanosprings for growing bone. Furthermore, the University of Idaho and the 3M Corporation have signed a non-disclosure agreement and talks between the principal investigators and 3M have begun about this technology.

Development of the Technology: Silica nanosprings were developed by the laboratory of Dr. McIlroy. The utilization of nanosprings for the growth of bone cells was developed as a collaboration between Dr. McIlroy and Dr. Arrizabalaga and experimentally performed by Jamie Hass DVM, a graduate student co-sponsored by both laboratories. Funding for this project was provided through BANtech by an University of Idaho Research initiative.

Theoretical Soundness of the Project: Modern biomaterials utilized for orthopedic enhancements fall within three categories: metal, ceramic and polymer coatings. Polymers such as ultrahigh molecular weight polyethylene (UHMWPE) are now incorporated into total knee and hip replacements. Studies have shown that a deposition of nanostructured titanium onto UHMWPE has increased osteoblast proliferation and calcium deposition. We propose to use a new nanomaterial, metal/metal alloy coated silicon dioxide nanosprings, to enhance orthopedic devices. Our nanosprings can be grown on any device, are easily sterilized, are biocompatible, do not have laminate separation. Furthermore, because they can be coated with a variety of factors, including metals and proteins they are adaptable to diverse functions. Nanomaterial enhanced orthopedic implants have a tremendous increase in surface area allowing for more contact between the bone and the implant. In addition, metal nanoparticles can be embedded in coating, on the surface of a device or delivered as free particles in solution. Cell attachment, growth and proliferation can be enhanced by nanosurfaces. The nanosprings have an advantage over other nanoparticles by greatly increasing the surface area that the osteoblasts can interact with. The nanosprings can be coated with other metals alloys and nanoparticles that allow diverse conjugating ability.

Maturity, Viability and Integration Risk of the Technology: The technology of using nanosprings for the growth of bone cells is in the "technology development" stage. This represents a Technology Readiness Level of TRL5-6. All the basic technology needed for the system have been established as well as the initial research to prove feasibility and establish the technology. The next steps will be to show that the system can work within the context of human and animal prostheses and implants. The need for materials that are inert and can be used to tighten the bonds between implants and bone has led to the analysis of conventional adhesive and materials as prostheses coatings. Thus, any new technology on this area is highly viable and likely to bring financial gains in both the short and long-term. Adoption of nanospring coatings for human prosthesis would require testing and approval from the Food and Drug Administration, meaning that implementation of coated nanosprings in prosthesis is at least ten years out. Approval for human use is therefore the greatest integration risk for the technology. Nonetheless, minimization of such risk will be accomplished by creating short term, midterm and long-term benchmarks. In the short term, the sales of nanospring coated cell cultures for testing and development of the technology will increase GoNano Technologies (an Idaho company) sales, thereby requiring them to expand their production facilities and increase their employee power. While approval for human use is a slow and difficult process the same timeline and roadblocks do not apply to use in animals. Therefore, as a midterm goal we will promote the use of nanospring coatings in animal prostheses. While this will by no means be as large a market as for human use, it should help to cover the gap before approval for human adoption, which is our long-term benchmark.

10. Commercialization Partners

GoNano Technologies is an ongoing partner and has been supplying the research project with samples per their agreement with the University of Idaho. The University's relationship with the 3M Corporation in respect to the use of nanosprings for bone growth has progressed to the point of establishment of a non-disclosure agreement (NDA). We hope to be able to work with 3M or a similar company on the continued development of nanospring coatings for prostheses but need gap funding in order to perfect the technology.

11. Specific Project Tasks, Benchmarks and Use of Funds:

The tasks to be undertaken in the next year will center around optimizing the conditions of bone growth on coated nanosprings and the characterization of the bone material formed on this surface. Optimization is critical for being able to enter animal testing stage and to secure support from industrial partners. With this goal in mind our benchmarks will be: a. completion of IP and patent applications (August 2011); b. determination of best coating for proliferation of osteoblasts (October 2011); c. complete mechanical studies of bone grown of nanosprings (December 2012); d. publication of results in peer reviewed journal (January 2012); e. initiate studies covering prosthetic materials with nanosprings to prove commercialization prospects of technology (January 2012); f. establish concrete contacts with private sector institutions (January 2012); g. conclude pilot studies with prostheses (June 2012) and transfer technology to private company or investors (June 2012).

The personnel team will consist of graduate student Jamie Hass, an undergraduate intern and professors Dr. Arrizabalaga and Dr. McIlroy. For qualifications of the principal investigators see section 4 (Investigators Directing Project) and biographical sketches in the appendices. Jamie Hass is a graduate student at the University of Idaho in the physics department. She is a Doctor of Veterinary Medicine and has over 20 years of clinical experience. Her veterinary experience, combined with her physics experience, makes her the ideal person for this project. Funds are requested to cover Jamie Hass's research assistantship (~$32K) from July 1, 2011 to June 30th, 2012. We are also requesting funds for a research internship for and undergraduate student. We anticipate laboratory expenditures for the project will be in the range of $14,000. $900 will be allocated to publication and documentation costs.

12. Education and Outreach:

One of the University of Idaho's missions is to increase interdisciplinary collaborations, education and training. This project will provide unparalleled training for the graduate student and the undergraduate intern on the project. The uniqueness of the training lies in the fact that the students will become fluent and proficient in several fields including cell biology, physics, chemistry and material science. In addition, both PIs are mentors for the INBRE summer fellowship program, though which the have and will involve undergraduate students from various Idaho institutions in nanospring based projects.

13. Institutional support

The University of Idaho has provided substantial support for the inception of this project through its approximately $1.5 million in the development of a bionanotechnology program. Funds provided by the University of Idaho Biological Applications of Nanotechnology (BANTech) Initiative were used to initially fund the graduate student performing the pilot studies of bone culture on nanospring-coated surfaces as well as all the materials needed for the work. Furthermore, the University of Idaho provides both principal investigators with laboratory space and access to cell biology and microscopy cores.

SUMMARY PROPOSAL BUDGET

Name of Institution: University of Idaho

Name of Project Director: David McIlroy

A. FACULTY AND STAFF Name/ Title	Rate of Pay	No. of Months CAL	 ACA	 SUM	Dollar Amount Requested
% OF TOTAL BUDGET:				**SUBTOTAL:**	

B. VISITING PROFESSORS Name/ Title	Rate of Pay	No. of Months CAL	 ACA	 SUM	Dollar Amount Requested
% OF TOTAL BUDGET:				**SUBTOTAL:**	

C. POST DOCTORAL ASSOCIATES / OTHER PROFESSIONALS Name/ Title	Rate of Pay	No. of Months CAL	 ACA	 SUM	Dollar Amount Requested
% OF TOTAL BUDGET:				**SUBTOTAL:**	

D. GRADUATE / UNDERGRADUATE STUDENTS Name/ Title	Rate of Pay	No. of Months CAL	 ACA	 SUM	Dollar Amount Requested
Jamie Hass (graduate student)	32,000/yr	12			32,000
TBD (Summer intern)	1,000/mo			3	3,000
% OF TOTAL BUDGET:	70 %			**SUBTOTAL:**	35,000

E. FRINGE BENEFITS

Rate of Pay (%)	Salary Base	Dollar Amount Requested
GRAD STUDENT:3%	32,000	1000
SUMMER INTERN	3,000	100
	SUBTOTAL:	1100

F. EQUIPMENT: (List each item with a cost in excess of $1000.00.)

Item/Description	Dollar Amount Requested
SUBTOTAL:	

G. TRAVEL:

Dates of Travel (from/to)	No. of Persons	Total Days	Transportation	Lodging	Per Diem	Dollar Amount Requested
					SUBTOTAL:	

H. Participant Support Costs:

	Dollar Amount Requested
1. Stipends	

2. Travel (other than listed in section G)	
3. Subsistence	
4. Other	
SUBTOTAL:	

I. Other Direct Costs:	Dollar Amount Requested
1. Materials and Supplies	14,000
2. Publication Costs/Page Charges	900
3. Consultant Services (Include Travel Expenses)	
4. Computer Services	
5. Subcontracts	
6. Other (specify nature & breakdown if over $1000)	
SUBTOTAL:	10,900

J. Total Costs: (Add subtotals, sections A through I)	TOTAL:	50,000
K. Amount Requested:	TOTAL:	50,000

Project Director's Signature: [signature]	Date:12-2-10

Budget Explanation:

The requested funds will be used to support the graduate student on the project, Jamie Hass, cover supplies associated with the project, and the publication costs of the work.

Appendices:

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Facilities and Equipment:

Dr. McIlroy's Facilities:

Dr. McIlroy has a well-equipped laboratory capable of processes and characterizing the test material used in this study. He has the capabilities to coat the nanosprings with Au, Ag, TiO2, ZnO, and combinations thereof. He has analysis capabilities, which include x-ray photoelectron spectroscopy and an atomic force microscope for mechanical testing of the artificial bone. The university has state-of-the-art electron microscopy facilities that include a field emission scanning electron microscope and transmission electron microscope.

Dr. Arrizabalaga's Facilities:

Dr. Arrizabalaga's laboratory is a state-of-the-art cell biology laboratory with BL-2 cell culture capabilities including 2 laminar flow tissue culture hoods, 4 tissue culture incubators and freezers for cryopreservation. Dr. Arrizabalaga's lab has access to 4 autoclaves. In addition, Dr. Arrizabalaga's lab has 2 microscopes with fluorescence and digital imaging capabilities. Furthermore, the laboratory is stocked with all material and reagents needed for cell culture growth and testing of proliferation, viability and differentiation. Dr. Arrizabalaga also routinely performs animal model based experiments and has access to the Laboratory Animal Research Facility at the University of Idaho.

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Biographical Sketches:

Gustavo Arrizabalaga

Department of Microbiology, Molecular Biology and Biochemistry

University of Idaho

Moscow, ID 83844-0903

tel. (208) 885-6079

e-mail: Gustavo@uidaho.edu

Professional Preparation

1992 B.S., Chemistry with Biology concentration, Haverford College, Haverford, PA

1999 Ph.D., Massachusetts Institute of Technology, Cambridge, MA

Post-doctoral fellowship, Stanford University School of Medicine, Stanford, CA

Appointments

2009-present Associate professor, Department of Microbiology, Molecular Biology and Biochemistry, University of Idaho, Moscow, ID
2004-2009 Assistant professor, Department of Microbiology, Molecular Biology and Biochemistry, University of Idaho, Moscow, ID
2004-present Faculty, WWAMI Medical Education Program
2007-present Adjunct Faculty, School of Molecular Sciences, Washington State University

1999-2004 Post-doctoral fellow, Stanford University School of Medicine, Stanford, CA
1993-1999 Doctoral Student, Massachusetts Institute of Technology, Cambridge, MA
1992 Research Lab Technician, Dupont Pharmaceuticals, Willmington, DE

Honors and Awards:

- R.M. Wade Teaching Excellence Award, College of Agriculture and Life Sciences, 2010
- Carl Storm Fellowship, Gordon Research Conferences, 2007

Research grants

Over $2.5 million of grant monies have been obtained to fund research on the human parasite Toxoplasma gondii.

Currently active grants as principle investigator include:

NIH RO1 AI 89808-01

American Cancer Society RSG-08-19-01-MBC

David McIlroy

Department of Physics

University of Idaho

Moscow, ID 83844-0903

tel. (208) 885-6809, FAX: (208) 885-4055

e-mail: DMCILROY@UIDAHO.EDU

Professional Preparation

1984 B.A., Physics,University of California, Santa Cruz

1993 Ph.D., Physics, University of Rhode Island

Appointments

2010-present	Chair of Physics
2007-present	Professor, Physics, University of Idaho
2002 – 2007	Associate Professor, Physics,University of Idaho
1996 - 2002	Assistant Professor, Physics, University of Idaho
1995 – 1996	Assist. Research Prof., Physics, University of Nebraska,
1993 – 1994	Research Associate, Physics, University of Nebraska
Summers (1992 & 1993)	Research Assistant, Sandia National Laboratory, Albuquerque, Research
1986 – 1987	Project Engineer, Sierracin Transflex, Bell, CA
1985 – 1986	Project Engineer, Watkins - Johnson Co., Scotts Valley, CA
1984 – 1985	Quality Control Engineer, Synertek, Santa Cruz, CA

Honors and Awards:

- Sigma Xi Society, 1989
- Outstanding Faculty Award from Disabled Student Services - UI - 2001
- University of Idaho Excellence in Research Award - 2004

Director of University of Idaho Biological Applications of Nanotechnology (BANTech) Initiative: The University of Idaho has invested approximately $1.5 million in the development of a bionanotechnology program that has 11 faculty members drawn from 8 departments and three colleges. The program is designed to provide cohesive research network that provides researchers and students from vastly different disciplines together to develop fundamental and applied applications of nanomaterials in biological and biomedical research.

SILVER VALLEY VETERINARY CLINIC
Douglas Walker, DVM
44650 Silver Valley Road – PO Box 250
Pinehurst, ID 83850
Telephone: (208) 682-2771 Fax: (208) 682-4142
Email: silvervalleyveterinaryclinic@gmail.com

November 6, 2010

Dr. Jamie Hass
Graduate Student
Physics Department
University of Idaho
Moscow, ID 83844

Dear Dr. Hass:

I appreciate the opportunity to comment on your current research. In our rural practice we see a tremendous amount of trauma especially to our small animal patients. This trauma often results in multiple types of fractures and dislocations. Similar to human medicine many of these fractures have to be repaired with a surgical implant. The Nanospring Osteointegration Technique could be extremely valuable to enable us to enhance our implant bone interface.

This research is extremely exciting. The idea of being able to coat these nanosprings with different types of metals furthers the diversity of this research. The lack of implant bone integration has always been a problem in orthopedic surgery. This osteointegration technique will help bridge this gap in orthopedic surgery.

The results of your research have been good and hopefully will continue to show promise. Please keep me advised on your progress.

Sincerely,

Douglas Walker, DVM
Owner Silver Valley Veterinary Clinic, PA
Member Idaho State Board of Veterinary Medicine

Dean A. Hendrickson, DVM, MS, Diplomate ACVS
Hospital Director
300 W Drake Road
Fort Collins CO 80523-1620
Office Phone: (970) 297-1269
Office Fax: (970) 297-4100
Email: dean.hendrickson@colostate.edu

Colorado State University
VETERINARY TEACHING HOSPITAL

November 5, 2010

Dr. Jamie Hass
Graduate Student
Physics Department
University of Idaho
Moscow, Idaho 83844

Dear Dr. Hass,

Thank you for the opportunity to comment on your work. As a surgeon, I certainly understand the importance of the bone, implant, interface. It is so critical to find a way to make the interface more of a seamless transition so that we have better integration of our implants into the bone, and vice versa. In so many instances with current implants, the rigidity of the implant, combined with the lack of osseointegration leaves us with a greater chance of failure, or increases the likelihood of future revision surgeries.

The integration of techniques such as nanosprings with coatings that encourage osseointegration should improve surgical implants for all species. I am very encouraged with the early results you have shown, and look forward to seeing this product move towards the market place where it can be used to better provide a transition zone including the bone and the implant, rather than an adjacency zone between the bone and the implant.

Please don't hesitate to contact me if you have any questions or if I can be of any further help at: 970-297-4554 or dean.hendrickson@colostate.edu

Sincerely,

Dean A. Hendrickson, DVM, MS, Diplomate ACVS
Hospital Director
Professor of Surgery

JAMIE L. HASS

PO Box 250
Pinehurst, ID 83850
Phone: (208) 660-7297
Email: hass0681@vandals.uidaho.edu

EDUCATION

2008-present	Physics Graduate PhD student, University of Idaho
2010	Physics MS
2008	Physics BS, Mathematics Minor, University of Idaho, Moscow, ID
2004-2005	North Idaho College

RESEARCH PROJECT

2010-present	Increasing proliferation, differentiation and calcium deposition of normal human osteoblasts using silicon dioxide nanosprings
2009-2010	In Vitro Determination of Delivery of mRNA Intracellular Using Silicon Dioxide Nanowires as the Drug Delivery System
2007-Present	In Vivo Analysis of Nanowires
2007	Conjugation of Nanowires with Fluorescent Dye REU
2006	Biological Application of Magnetic Nanoparticles

EMPLOYMENT

Spring /Summer 2010	Research Assistant
Fall 2009	Teaching assistant for Physics 212 lab/grading
Summer 2009	Research Assistant for Bantech
	Teaching Physics 211 Class and Lab
Spring 2009	Teaching Assistant for Physics Lab 211
Fall 2008	Teaching Assistant for Physics Lab 111, 211 and recitation
Summer 2008	Research assistant with BanTech
Spring 2007 & 2008	Grading for Physics 211
Fall 2006	Grading Math 310-Ordinary Differential Equations

TEACHING EXPERIENCE

Spring 2010	Part of team teaching of Biological Application of Nanomaterials "Pharmacokinetics of Nanomaterial"; PH 404/504
Summer 2009	University of Idaho, Physics for Scientist and Engineers I and Lab; PH 211

PRESENTATIONS

Summer 2010	Proliferation of Normal Human Osteoblasts Using Silicon Dioxide Nanosprings, 9th Annual Idaho INB RE Research Conference Moscow, Idaho

INBRE Fellowship recipient Fall 2010

Recipient of Physics Department Teaching Assistant 2010
Nomination for Teaching assistant of the year for U of I Spring 2009
Dean's List Spring 2008
Dean's List Fall 2007

Involvement in Student Physics Society 2007-2008

Peer Reviewer for Canadian Light Source

CURRICULUM VITAE

NAME: McIlroy, David Nevil

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EDUCATION BEYOND HIGH SCHOOL:

B.A., Physics, 1980-1984, University of California, Santa Cruz, California
Ph.D., Physics, 1987-1993, University of Rhode Island, Kingston, Rhode Island

EXPERIENCE:

In Educational Institutions Since Receipt of Bachelor's Degree:

Teaching and Research:

September 1987-April 1993, Teaching Assistant, Department of Physics, University of Rhode Island. Supervisor: D.R. Heskett
September 1991-May 1993, Instructor, Department of Physics, University of Rhode Island. Supervisor: S. Malik
May-September 1992, Research Assistant, Sandia National Laboratory. Supervisor: E. Chason
May-July 1993, Research Assistant, Sandia National Laboratory. Supervisor: E. Chason
August-December 31, 1993, Research Associate in Physics, University of Nebraska-Lincoln. Supervisor: Professor P.A. Dowben
January 1, 1995-August 1, 1996, Research Assistant Professor, Department of Physics and Astronomy, University of Nebraska-Lincoln
July 1, 1996-2002, Assistant Professor, Department of Physics, University of Idaho
July 28, 2002-present, Associate Professor, Dept. of Physics, University of Idaho

Major Committee Assignments:

Advisory Committee of the Sychrotron Radiation Center, University of Wisconsin, Stoughton, Wisconsin

Other Professional:

Employment:

July-December 1984, Quality Engineer, Synertek, Santa Cruz, California
January 1985-June 1986, Project Engineer, Watkins-Johnson Company, Scotts Valley, California
October 1986-August 1987, Project Engineer, Sierracin Transflex, Bell, California

Membership in Professional and Scholarly Organizations:

American Physical Society
Materials Research Society
Sigma Xi

PUBLICATIONS:

Refereed Publications:

Tang, D., D. McIlroy, X. Shi, C. Su, and D. Heskett. 1991. The Structure of Na Overlayers on Cu(111) at Room Temperature. *Surf. Sci.* 255, L497.

Heskett, D., D. McIlroy, D.M. Swanston, A.B. McLean, N.J. DiNardo, H. Munekata, and R. Ludeke. 1992. Strain and the Two-Dimensional Electronic Structure of Monolayers of Bi/InAs(110). *J. Vac. Sci. Technol.* B10, 1949.

Swanston, D.M., A.B. McLean, D.N. McIlroy, D. Heskett, R. Ludeke, H. Munekata, M. Prietsch, and N.J. DiNardo. 1992. The Electronic Structure of MBE Grown InAs(110). *Canadian Journal of Physics* 70, 1099.

McIlroy, D.N., D. Heskett, D.M. Swanston, A.B. McLean, N.J. DiNardo, M. Prietsch, R. Ludeke, and H. Munekata. 1993. Occupied Surface State Bands of Bi (1x1) Overlayers on an InAs(110) Surface Grown by Molecular-Beam Epitaxy. *Phys. Rev.* B47, 3751.

Chason, E., T.M. Mayer, D.N. McIlroy, and C.M. Matzke. 1993. Ion Bombardment of SiO_2/Si and Si Measured by In Situ X-Ray Reflectivity. *Nucl. Instrum. and Methods Phys. Res.*, Sect. B, 80/81, 742.

McIlroy, D.N., D. Heskett, A.B. McLean, R. Ludeke, H. Munekata, and N.J. DeNardo. 1993. A Polarization Study of the p(1x1)- and p(1x2)-phases of Bi/GaSb(110) Using Linearly Polarized Synchrotron Radiation. *J. Vac. Sci. Technol.* B 11, 1486.

McIlroy, D.N., D. Heskett, A.B. McLean, R. Ludeke, H. Munekata, and N.J. DeNardo. 1993. The Electronic Band Structure of the p(1x1)- and p(1x2)-phases of Bi/GaSb(110). *Phys. Rev.* B48, 11897.

Zhang, Jiandi, D.N. McIlroy, and P.A. Dowben. 1994. Changes in Electron Localization and Density of States Near E_F Across the Nonmetal-Metal Transition in Mg Overlayers. *Phys. Rev.* B49, 13780.

Chason, E., T.M. Mayer, B.K. Kellerman, D.N. McIlroy, and A.J. Howard. 1994. Roughening Instability and Evolution of Ge(001) Surface During Ion Sputtering. *Phys. Rev. Lett.* 72, 3040.

Swanston, D.M., A.B. McLean, D.N. McIlroy, D. Heskett, R. Ludeke, H. Munekata, M. Prietsch, and N.J. DiNardo. 1994. Surface Localized States on InAs(110). *Surf. Sci.* 312, 361.

Zhang, Jiandi, D.N. McIlroy, and P.A. Dowben. 1995. Changes in the Electron Effective Mass Across the Nonmetal-Metal Transition in Magnesium Overlayers. *Europhys. Lett.* 29, 469.

McIlroy, D.N., Jiandi Zhang, P.A. Dowben, P. Xu, and D. Heskett. 1995. The Coadsorption of Metals and Molecular Icosahedra on Cu(100). *Surf. Sci.* 328, 47.

McIlroy, D.N., and P.A. Dowben. 1995. The Paramagnetic Correlation Length of Mn Thin Films. *Mat. Res. Soc. Symp. Proc.* 375, 81.

Li, D., J. Pearson, S.D. Bader, D.N. McIlroy, C. Waldfried, and P.A. Dowben. 1995. Spin-Polarized Photoemission Studies of the Exchange Splitting of the Gd 5d Electrons Near the Curie Temperature. *Phys. Rev.* B51, 13895.

Refereed Publications (cont.):

McLean, A.B., D.M. Swanston, D.N. McIlroy, D. Heskett, R. Ludeke, and H. Munekata. 1995. InAs(110)-p(1X1)-Sb(1ML): Electronic Structure and Surface Bonding. *Phys. Rev.* B51, 14271.

Zhang, J., D.N. McIlroy, P.A. Dowben, H. Zeng, G. Vidali, D. Heskett, and M. Onellion. 1995. The Electronic Structure of Molecular Icosahedra Films. *J. Phys.: Condens. Matter* 7, 7185.

McIlroy, D.N., P.A. Dowben, A. Knop, and E. Rühl. 1995. A Novel Design for a Small Retractable Cylindrical Mirror Analyzer. *J. Vac. Sci. Techol.* B 13(5), 2142.

Zhang, Jiandi, D.N. McIlroy, and P.A. Dowben. 1995. The Correlation Between Screening and Electron Effective Mass Across the Nonmetal-Metal Transition in Ultrathin Films. *Phys. Rev.* B52, 11380.

McIlroy, D.N., J. Zhang, S.-H. Liou, and P.A. Dowben. 1995. Changes in Screening and Electron Density Across the Coupled Metallic-Magnetic Phase Transition of $La_{1-x}Ca_xMnO_3$. *Phys. Lett.* A, 207, 367.

Waldfried, C., D.N. McIlroy, Dongqi Li, J. Pearson, S.D. Bader, and P.A. Dowben. 1995. Dissociative Nitrogen Chemisorption and Bonding on Gd(0001). *Surf. Sci. Lett.* 341, L1072.

Zhang, J., D.N. McIlroy, P.A. Dowben, S.H. Liou, R.F. Sabirianov, and S.S. Jaswal. 1996. The Valence-Band Structure of $La_{1-x}Ca_xMnO_3$. *Solid State Commun.* 97, 39.

Knop, A., D.N. McIlroy, P.A. Dowben, and E. Rühl. 1996. Argon Electron Spectroscopy of Free Agron Clusters. In Two-Center Effects in Ion-Atom Collisions, *AIP Conference Proceedings* 362, edited by T.J. Gay and A.F. Storace (Lincoln, Nebraska, 1994), p. 274.

McIlroy, D.N., C. Waldfried, Dongqi Li, J. Person, S.D. Bader, D.-J. Huang, P.D. Johnson, R.F. Sabirianov, S.S. Jaswal, and P.A. Dowben. 1996. Oxygen Induced Suppression of the Surface Magnetization of Gd(0001). *Phys. Rev. Lett.* 76, 2802.

Waldfried, C., D.N. McIlroy, Jiandi Zhang, P.A. Dowben, G.A. Katrich, and E.W. Plummer. 1996. The Determination of the Surface Debye Temperature of Mo(112) Using Valence Band Photoemission. *Surf. Sci.* 363, 296.

Rühl, E., A. Knop, A.P. Hitchcock, P.A. Dowben, and D.N. McIlroy. 1996. Core Excitations in Free Clusters: Ionization, Relaxation, and Fragmentation. *Surf. Rev. Lett.* 3, 557.

McIlroy, D.N., J. Zhang, P.A. Dowben, and D. Heskett. 1996. Band Gaps of Doped and Undoped Films of Molecular Icosahedra. *Mat. Sci. and Eng. A* 217/218, 64.

Dowben, P.A., D.N. McIlroy, J. Zhang, and E. Rühl. 1996. When are Thin Films of Metals Metallic? Part III. *Mat. Sci. and Eng. A* 217/218, 258.

Waldfried, C., D.N. McIlroy, C.W. Hutchings, and P.A. Dowben. 1996. Strain Induced Distortion of the Bulk Bands of Gadolinium. *Phys. Rev. B* 54, 16460.

McIlroy, D.N., C. Waldfried, J. Zhang, J.-W. Choi, F. Foong, S.H. Liou, and P.A. Dowben. 1996. A Comparison of the Temperature Dependent Electronic Structure of the Perovskites $La_{0.65}A_{0.35}MnO_3$ (A=Ca,Ba). *Phys. Rev. B* 54, 17438.

Refereed Publications (cont.):

Hwang, S.-D., N.B. Remmes, P.A. Dowben, and D.N. McIlroy. 1996. Nickel Doping of Boron Carbide Grown by Plasma Enhanced Chemical Vapor Deposition. *J. Vac. Sci. Technol. B* 14, 2957.

Waldfried, C., D.N. McIlroy, S.-H. Liou, R. Sabirianov, S.S. Jaswal, and P.A. Dowben. 1997. The Observation of a Surface Resonance State in the Valence Band Structure of the Perovskite $La_{0.65}Ca_{0.35}MnO_3$. *J. Phys.: Condens. Matter* 9, 1031.

Hwang, Seong-Don, P.A. Dowben, Ahmad A. Ahmad, N.J. Ianno, J.Z. Li, J.Y. Lin, H.X. Jiang, and D.N. McIlroy. 1997. Fabrication of n-Type Nickel Doped $B_5C_{1+?}$ Homojunction and Heterojunction

Diodes. *Appl. Phys. Lett.* 70, 1028.

McIlroy, D.N., C. Waldfried, and P.A. Dowben. 1997. Distortion Driven Splitting of the Hubbard Bands of an Icosahedral Matrix Structure. *Chem. Phys. Lett.* 264, 168.

Hwang, S.-D., P.A. Dowben, A. Cheeseman, J.T. Spencer, and D.N. McIlroy. 1997. Phosphorus Doping of Boron Carbon Alloys. *Mat. Res. Soc. Symp. Proc.* Vol. 452, 1031.

Hwang, S.-D., N. Remmes, P.A. Dowben, and D.N. McIlroy. 1997. Nickel Doping of Boron-Carbon Alloy Films and Corresponding Fermi Level Shifts. *J. Vac. Sci. and Technol.* A 15, 1.

Waldfried, Carlo, D.N. McIlroy, and P.A. Dowben. 1997. The Electronic Structure of Gadolinium Grown on MO(112). *J. Phys: Condens. Matter* 9, 10615.

McIlroy, D.N., S.-D. Hwang, Ken Yang, N. Remmes, P.A. Dowben, Ahmad A. Ahmad, N.J. Ianno, J.Z. Li, J.Y. Lin, and H.X. Jiang. 1998. The Incorporation of Nickel and Phosphorus Dopants into Boron-Carbon Alloy Thin Films. *Applied Physics A: Materials and Processing* V 69, 335.

Zhang, Daqing, D.N. McIlroy, W.L. O'Brien, and Gelsomina De Stasio. 1998. The Chemical and Morphological Properties of Boron-Carbon Alloys as Determined by Imaging Photoelectron Spectromicroscopy. *J. Mater. Sci.* 33, 4911.

Zhang, D.Q., D.N. McIlroy, Y. Geng, and M.G. Norton. 1999. Growth and Characterization of Boron Carbide Nanowires. *J. Mat. Sci. Lett.* 18, 349.

Zhang, D., B.G. Kempton*, D.N. McIlroy, Y. Geng, and M.G. Norton. 1999. Synthesis of Boron Carbide Nanowires and Nanocrystal Arrays by Plasma Enhanced Chemical Vapor Deposition. *Mat. Res. Soc. Proc.*, Vol. 536, 323.

McIlroy, D.N., Daqing Zhang, Robert M. Cohen*, J. Wharton*, Yongjun Geng, M. Grant Norton, Gelsomina De Stasio, B. Gilbert, L. Perfetti, J.H. Streiff, B. Brooks, and Jeanne L. McHale. 1999. Electronic and Dynamic Studies of Boron Carbide Nanowires, *Phys. Rev. B* 60, *4874.*

McIlroy, D.N., Daqing Zhang, Bradley Kempton*, J. Wharton*, R.T. Littleton, T.M. Tritt, C.G. Olson. 2000. A High-Resolution Angle-Resolved Photoemission Study of the Temperature Dependent Electronic Structure of the Pentatelluride $ZrTe_5$. *Mat. Res. Soc. Proc.Vol. 590, 57*.

McAvoy, T., J. Zhang, C. Waldfried, D.N. McIlroy, and P.A. Dowben. 2000. The Interplay Between the Surface Band Structure and Possible Surface Reconstructions of Mo(112). *The European Journal of Physics B 14, 747.*

Refereed Publications (cont.):

Zhang, D., Davalle*, D. M., O'Brien, W. L., McIlroy, D. N.. 2000. The Chemical Composition of As-grown and Surface Treated Amorphous Boron Carbon Thin Films by Means of NEXAFS and XPS, *Surface Science 461, 16.*

McIlroy, D. N., Zhang, D., Norton, M. Grant, O'Brien, W. L., Schwickert, M. M., Harp, G. R.. 2000. Synthesis and Reactivity of Fe Nanoparticles Embedded in a Semi-insulating Matrix, *Journal of Applied Physics 87, 7213.*

McIlroy, D. N., Zhang, D., Kranov, Y., Norton, M. Grant. 2001. Nanosprings, *Applied Physics Letters 79, 1540*

F. M. El-Hossary, N. Z. Negm, S. M. Khalil, A. M. Abed Elrahman, and D. N. McIlroy, 2001. RF Plasma

Carbonitriding of AISI 304 Austenitic Stainless Steel, *Surface and Coatings Technology 141, 194.*

L. Bergman, L., Chen, Xiang-Bai, McIlroy, D., and Davis, R. F.. 2002. Probing the AlxGa1-xN Spatial Alloy Fluctuation via UV-Photoluminescence and Raman at Sub-?m Scale, *Applied Physics Letters* 81, 4186.

Ye, Xiang R., Wai, Chien M., Zhang, Daqing, Kranov, Yanko, McIlroy, David N.. 2003. Immersion Deposition of Copper Films on Silicon Substrates in Liquid and Supercritical Carbon Dioxide, *Chemistry of. of Materials 15, 83.*

Zhang, D., Alkhateeb, A., Han, H., Mahmood, H., McIlroy, David N., and Norton, M. G., 2003. Silicon Carbide Nanosprings, *Nano Letters* 3, 983.

McIlroy, D. N., Zhang, D., Kranov, Y., Han, H., Alkhateeb, A., Norton, M. Grant, 2003. The Effects of Crystallinity and Catalyst Dynamics on Nanospring Formation, Materials Research Society Proceedings Vol. 739.

Caruso, A. N. Balaz, Snjezana, Xu, Bo, Dowben, P. A., McMullen-Gunn, A. S., Brand, J. I., Losovyj, Y. B., McIlroy, D. N., 2003, The Surface Photovoltage Effects on the Isomeric Semiconductors of Boron-Carbide, accepted to Applied Physics Letters.

McIlroy, D. N. Zhang, Daqing, Wharton, J., Kempton*, B., Littleton, R., Wilson, M., Tritt, T. M., Olson, C. G.. 2002. Observation of a Semimetal-Semiconductor Phase Transition in the Intermetallic $ZrTe_5$, *submission pending.*

* Denotes Undergraduate

Review Articles:

Dowben, P.A., D.N. McIlroy, and Dongqi Li. Surface Magnetism of the Lanthanides. In *Handbook on the Physics and Chemistry of Rare Earths*, Vol. 24, edited by K.A. Gschneidner, Jr. and L. Eyring (North-Holland, Amsterdam), ch. 159, p. 1.

McIlroy, D.N. 1998. Progress in the Development of High Temperature Semiconducting Boron-Carbon Alloys 79. *Recent Research Developments in Applied Physics*, edited by S.G. Pandalai (Transworld Research Network).

McIlroy, D. N., Zhang, Daqing, Alkhateeb, A., Aston, D. E., Marcy, Andrew C., Norton, M. Grant, Nanospring, the Next Piece of the Nanotechnology Puzzle?, Journal of Condensed Matter Physics, in press.

PATENTS:

A Design for a Small Retractable Cylindrical Mirror Analyzer, P. A. Dowben, Carlo Waldfried, Tara J. McAvoy and D. N. McIlroy
U.S. Pat. # 6,184,523 (Feb. 6, 2001)

Methods of Forming Materials Containing Carbon and Boron, Methods of Forming Catalysts, Filaments Comprising Boron and Carbon, and Catalysts, D. N. McIlroy
U.S. Pat.# 6,235,675 (May 22, 2001)

INVITED TALKS: (1996-present)

An Examination of the Coupled Magnetic-Metallic Phase Transition of Doped Transition Metal Perovskites. Naval Research Laboratory, Washington, D.C., April 22, 1996.

An Examination of the Coupled Magnetic-Metallic Phase Transition of Doped Transition Metal Perovskites. University of New Orleans, New Orleans, Louisiana, April 29, 1996.

An Examination of the Coupled Magnetic-Metallic Phase Transition of Doped Transition Metal Perovskites, Washington State University, Pullman, Washington, October 1, 1996.

Clusters vs. Solids: How Different Are They? Synchrotron Radiation Center Workshop on Dichroism and Nanostructures, Synchrotron Radiation Center, Stoughton, Wisconsin, November 16, 1996.

The Growth and Characterization of Boron Carbide Thin Films and Nanowires. Pacific Northwest Laboratory, Richland, Washington, April 21, 1998.

The Growth and Characterization of Boron Carbide Thin Films and Nanowires. Boise State University, Boise, Idaho, October 23, 1998.

The Many Phases of Boron Carbide, ASM/TMS Student Chapter, University of Idaho, Moscow, Idaho, March 30, 1999.

Fermi Surfaces of Pentatellurides. The Synchrotron Radiation Center – University of Wisconsin Users Meeting, Stoughton, Wisconsin, October 8, 1999.

Nanowires of Boron Carbide, Department of Materials Science, University of Washington, Seattle, Washington, October 18, 1999.

Growth and Characterization of Boron Carbide Nanowires, Department of Physics, Washington State University, Pullman, WA (April 25, 2000).

Growth and Characterization of Boron Carbide Nanowires, Department of Physics, Idaho State University, Pocatello, ID (May 5, 2000).

Boron Carbide Nanowires: A Model System for Studying Unique Types of Nanowire Growth, Nanotubes and Nanostructures 2000 Conference, Santa Margherita di Pula, Sardina, Italy (Oct. 3, 2000)

Boron Carbide Nanowires: A Model System for Studying Unique Types of Nanowire Growth, University of North Dakota, Grand Forks, ND (Nov. 16, 2000)

Nanostructured Composites and their Applications to Photonics, Eigth Annual International Conference on Composites Engineering ICCE/8, Tenerife, Canary Islands, Spain (August 7, 2001)

Boron Carbide Nanowires: A Model System for Studying Unique Types of Nanowire Growth, Lewis and Clark College, Portland, OR (Oct. 16, 2001)

Boron Carbide Nanowires: A Model System for Studying Unique Types of Nanowire Growth, Western Washington University, Bellingham, WA (Oct. 18, 2001)

Nanowires and Nanosprings, Naval Research Laboratory, Washington, DC (April 2, 2002)

Nanosprings: Growth and Modeling, Ninth Annual International Conference on Composite Engineering, San Diego, CA (July 4, 2002)

Nanowires and Nanosprings: Unexpected Catalyst Mediated Growth Phenomena, Materials Research Society, Boston, MA (Dec 4, 2002).

Nanowires and Nanosprings: Unexpected Catalyst Mediated Growth Phenomena, Department of Physics, University of Rhode Island, Kingston, RI (Dec 6, 2002).

The Effects of Crystallinity and Catalyst Dynamics on Nanospring Formation, Pacific Northwest National Laboratory, Richland, OR (February, 2003).

The Effects of Crystallinity and Catalyst Dynamics on Nanospring Formation, The Northwest Section of the American Physical Society, Portland, OR (May 31, 2003).

Nanosprings, Another Piece of the Nanotechnology Puzzle, The American Association of Physics Teachers, Madison, WI (Aug 5, 2003).

Nanosprings, Another Piece of the Nanotechnology Puzzle, The South East Section of the American Association of Physics Teachers, Madison, NC (Nov. 3, 2003).

The Effects of Crystallinity and Catalyst Dynamics on Nanospring Formation, North Caolina State University, Durham, NC (Nov. 5, 2003).

CONTRIBUTED PRESENTATIONS: (1996-present)

An Examination of the Coupled Magnetic-Metallic Phase Transition of the Doped Transition Metal Perovskites. American Physical Society, St. Louis, Michigan, March 20, 1996. Abstract: P.A. Dowben, C. Waldfried, Jiandi Zhang, S.-H. Liou, and D.N. McIlroy (presenter), *Bulletin Amer. Phys. Soc.* **41**, 358 (1996).

An Examination of the Coupled Magnetic-Metallic Phase Transition of the Doped Transition Metal Perovskites. American Physical Society, St. Louis, Michigan, March 20, 1996. Abstract: D.N. McIlroy, C. Waldfried, P.A. Dowben, and D. Heskett, *Bulletin Amer. Phys. Soc.* **41**, 10 (1996).

Photoemission Spectroscopy and LEED of Ultra-Thin Gd Films on Mo(112). American Physical Society, St. Louis, Michigan, March 20, 1996. Abstract: C.W. Hutchings, C. Waldfried, D.N. McIlroy (presenter), and P.A. Dowben, *Bulletin Amer. Phys. Soc.* **41**, 478 (1996).

Nickel Doping of Boron Carbide and Fermi Level Shifts. Third International High Temperature Electronics Conference, Albuquerque, New Mexico, June 11, 1996. P.A. Dowben, S.-D. Hwang, and D.N. McIlroy, *Proceedings of the Third International High Tempeature Electronics Conference*, Vol. 1, XII-3 (1996).

The Band Structure of Ultrathin Films and Strained Thick Films of Gd Grown on Mo(112). 56th Physical Electronics Conference, Boston, Massachusetts, June 18, 1996. Abstract: D.N. McIlroy, C. Waldfried, C.W. Hutchings, and P.A. Dowben, *Proc. of Phys. Elec. Conf.* **56** (1996).

Nickel Doping of Boron Carbide and Corresponding Fermi Level Shifts. 43rd National Symposium of the American Vacuum Society, October 15, 1996. Abstract: D.N. McIlroy, S.D. Hwang, N. Remmes and P.A. Dowben, *Proc. of the American Vacuum Society Conf.* **43** (1996).

Fabrication of p-n Homojunction Devices of the High Resistivity Polytype of Boron Carbide (B_5C), 1996 Fall Meeting of the Materials Research Society, December 5, 1996. Abstract: D.N. McIlroy, S.-D. Hwang, P.A. Dowben, A.A. Ahmad, and N.J. Ianno, *Proc. of Materials Research Society*, Fall 1996.

The Effects of Doping on the Transport and Device Characteristics of Boron-Carbon Alloy Materials. American Physical Society, Kansas City, Missouri, March 17, 1997. Abstract: D.N. McIlroy, J.Z. Li, J.Y. Lin, H.X. Jiang, N. Remmes, Ken Yang, S.-D. Hwang, and P.A. Dowben, *Bull. Amer. Phys. Soc.* **42**, 125 (1997).

Doped Boron-Carbon Alloys. Second International Conference on All Electric Combat Vehicle, June 11, 1997. Abstract: D.N. McIlroy, S.D. Hwang, Ken Yang, N. Remmes, P.A. Dowben, Ahmad A.

Ahmad, N.J. Ianno, J.Z. Li, J.Y. Lin, and H.X. Jiang, *Proc. of Second International Conference on All Electric Combat Vehicle.*

The Growth and Characterization of Boron-Carbon Nanotubes. American Physical Society, Los Angeles, California, March 17, 1998. Abstract: D.N. McIlroy, Daqing Zhang, J.H. Streiff, B. Brooks, Jeanne L. McHale, B. Gilbert, Luca Perfetti, Gelsomina De Stasio, *Bull. Amer. Phys. Soc.* **43**, 217 (1998).

The Chemical and Morphological Properties of Boron-Carbon Alloys. American Physical Society, Los Angeles, California, March 17, 1998. Abstract: Daqing Zhang, D.N. McIlroy, W.L. O'Brien, and Gelsomina De Stasio, *Bull. Amer. Phys. Soc.* **43**, 279 (1998).

Growth of Boron Carbide Nanowires and Nanocrystal Arrays by PECVD. The Materials Research Society, Boston, Massachusetts, December 2, 1998. Abstract: D.N. McIlroy, Daqing Zhang, Yongjun Zhang, M. Grant Norton, J.H. Streiff, Jeanne L. McHale, B. Brooks, and Gelsomina De Stasio, *Mat. Sci. Soc. Abs.*, 121, (1998).

Growth and Characterization of Boron Carbide Nanostructures, The American Physical Society, Atlanta, Georgia, March 25, 1999. Abstract: Daqing Zhang, D.N. McIlroy, J.H. Streiff, B. Brooks, Jeanne L. McHale, Yongjun Zhang, M. Grant Norton, *Bull. Amer. Phys. Soc.* **44**, (1999) 1582.

Temperature Dependent Photoemission Studies of Pentatelluride Thermoelectric Materials, The American Physical Society, Atlanta, Georgia, March 25, 1999. Abstract: D.N. McIlroy, Daqing Zhang, J. Wharton*, T.M. Tritt, M. Wilson, R.T. Littleton, J. Kolis, S.J. Chafe, and C.G. Olson, *Bull. Amer. Phys. Soc.* **44**, (1999) 226.

High Resolution Angle Resolved Photoemission Studies of the Temperature Dependent Electronic Structure of Thermoelectric Materials, The Materials Research Society, Boston, Massachusetts, December 2, 1999. Abstract: D.N. McIlroy, D. Zhang, Y. Kranov, B. Kempton*, T.M. Tritt, R.T. Littleton, C.G. Olson, *Mat. Sci. Soc. Abs.,* (1999) 298.

The Temperature Dependent Electronic Structure of Pentatellurides, The Materials Research Society, San Francisco, CA, April 24, 2000. Abstract: Bradley Kempton*, Daqing Zhang, D. N. McIlroy, T. M. Tritt, R. T. Littleton, C. G. Olson, Mat. Sci. Soc. Abs., (2000) 383.

High Resolution Angle Resolved Photoemission Studies of the Temperature Dependent Electronic Structure of the Pentatelluride $ZrTe_5$, The American Physical Society, Minneapolis, MN, March 20, 2000. Abstract: Daqing Zhang, D.N. McIlroy, B. Kempton*, T.M. Tritt, R. Littleton, C.G. Olson, *Bull. Amer. Phys. Soc.* **45**, (2000) 83.

Promotion of the Growth of Boron Carbide Nanowires, The American Physical Society, Minneapolis, MN, March 20, 2000. Abstract: Yanko Kranov, Daqing Zhang, David McIlroy, M. Grant Norton, *Bull. Amer. Phys. Soc.* **45**, (2000) 627.

The Characterization of Boron Carbide Nanowires Grown by PECVD and CVD, The American Physical Society, Seattle, WA, March 13, 2001. Abstract: Abdullah Alkhateeb, Daqing Zhang, D. N. McIlroy, M. Grant Norton, *Bull. Amer. Phys. Soc.* **46**, (2001) 340.

Growth and Modeling of Boron Carbide Nanosprings, The American Physical Society, Seattle, WA, March 13, 2001. Abstract: Daqing Zhang, Yanko A. Kranov, David N. McIlroy, M. Grant Norton, , *Bull. Amer. Phys. Soc.* **46**, (2001) 340.

Synthesis of Free Standing Iron Spheres by Plasma Enhanced Chemical Vapor Deposition, The American Physical Society, Seattle, WA, March 15, 2001. Abstract: Jason Marchinek, Abdullah Alkhateeb , Rex Gandy, David N. McIlroy, M. Grant Norton, B. L. Justus , *Bull. Amer. Phys. Soc.* **46**, (2001) 1054.

Growth and Characterization of Silicon Carbide Nanowires and Nanosprings, The American Physical

Society, Indianapolis, IN, March 22, 2002. Abstract: Daqing Zhang, Abdullah Alkhateeb, Sandra Wright, Yingwei Zhou, Leah Bergman, David McIlroy, and Grant Norton, *Bull. Amer. Phys. Soc.* **47**, (2002).

Tantalum Oxide Nanoislands and Continuous Films Grown by Atomic Layer Deposition, The American Physical Society, Autin, TX, March 6, 2003. Abstract: Daqing Zhang, Jiang Wei, Samuel Moore, Xiangbei Chen, Leah Bergman, D. Eric Aston, Batric Pesic, and David McIlroy, *Bull. Amer. Phys. Soc.* **48**, (2003).

Magnetic Pinning and Coupling of Magnetic Nanoantidot Arrays, The American Physical Society, Autin, TX, March 6, 2003. Abstract: Yanko Kranov, David McIlroy, Peter Dowben, Ruihua Cheng, B. L. Justus, A. Rosenberg, *Bull. Amer. Phys. Soc.* **48**, (2003).

The Effects of Catalyst Dynamics and Composition on Nanospring Formation, The American Physical Society, Autin, TX, March 6, 2003. Abstract: Abdullah Alkhateeb, Daqing Zhang, David N. McIlroy, and M. Grant Norton, *Bull. Amer. Phys. Soc.* **48**, (2003).

Nanoparticle Formation Using Nanochannel Glass in a Plasma Environment, Northwest American Physical Society, Portland, OR, May 30, 2003. Abstract: Ehab Marji, Dave McIlroy, Radha Padmanabhan, Hongmei Han, Rex Gandy, and Ashley Eadon.

* Denotes undergraduate

AWARDS

Outstanding Faculty Award – 2001, Student Disability Services

PROFFESIONAL DEVELOPMENT

Symposium organizer for the Fall meeting of the Materials Research Society, Boston, MA, December 2002.

Gave two lectures, one on nanowires and the other on nanosprings, at a summer course on Nanotechnology, May 23, 2003, at Pacific Northwest National Laboratory. The course was sponsored by Pacific Northwest National Laboratory and University of Washington.

Selection Committee for the Northwest Section of the American Physical Society

Summary of Submitted Proposals

Title:	Small Travel Grant - $900
Submitted:	November 20, 1996
Agency:	Idaho-Research Office
Status:	Awarded

Title:	Synchrotron Radiation Studies of Metal Doped Molecular Nanostructures - $6000
Submitted:	February, 1996
Agency:	Idaho-Research Office (Seed Grant)
Status:	Awarded

Title: Fragmentation and Incorporation of Metallo-Organic Complexes into Boron-Carbon Alloys - $20,000 (PI)
Submitted: February, 1997
Agency: The Petroleum Research Fund
Status: **Awarded**

Title: The Development of Amorphous Boron-Carbon Alloy Thin Films as Copper Diffusion Barriers for Semiconductor Interconnects - $3000
Submitted: April 23, 1997
Agency: NSF-Idaho EPSCoR
Status: Awarded

Title: Small Travel Grant - $900
Submitted: November 11, 1997
Agency: Idaho-Research Office
Status: Awarded

*Title: Thermoelectric Materials for Thermopower Conversion - $6000
Submitted: February 22, 1998
Agency: Idaho-Research Office (Seed Grant)
Status: Awarded

Title: Thermopower Materials for Onboard Energy Sources in Spacecraft and Satellites - $10,000
Submitted: March, 1998
Agency: NASA Idaho Space Grant Consortium
Status: Awarded

Title: Development of Materials for Low Power Solid State Refrigeration on Spacecraft - $10,000
Submitted: January, 1999
Agency: NASA Idaho Space Grant Consortium
Status: Awarded

Title: Growth, Self-Assembly, Electronic and Mechanical Characterization of Single Crystal Nanowires and Nanoarrays - $232,381 (PI)
Submitted: March, 1999
Agency: Office of Naval Research
Status: **Awarded (1999-2002)**

Title: Nanomagnetic Materials - $6,000
Submitted: February, 1999
Agency: University of Idaho Research Office
Status: Awarded

Title: Catalytic Ignitors for Clean-Burning, Flexible Fueled Aircraft Engines - $25,000 (co-PI)
Submitted: July, 1999
Agency: NASA-EPSCoR
Status: Awarded

Title: Search for Thermoelectric Materials in Pentatelluride Systems at Lower Temperatures ($T<273K$) - $1,000
Submitted: October, 1999
Agency: Materials Research Society
Status: Awarded

Title: Catalytic Ignition as a Tool for Converting Small Engines to Efficient JP-8 Operation - $384,000 (Co-PI)
Submitted: March, 2000
Agency: Department of Defense
Status: **Awarded**

Title: Two-Dimensional Photonic Crystals for Near IR and Visible Optoelectronics Applications - $332,265 (PI)
Submitted: July, 2000
Agency: Air Force Office of Scientific Research
Status: **Awarded (2001-2004)**

Title: Nanosprings:Exploring Mechanics at the Nanoscale - $860,443 (PI)
Submitted: November, 2002
Agency: W.M. Keck Foundation
Status: **Awarded (2003-2007)**

Title: A New Method of Using Semiconductor Nanowires for Detection of Molecules and Hazardous Substances in Air Using AC Electrical Techniques - $642,842 (co-PI)
Submitted: August, 2003
Agency: DoD
Status: Pending

Title: NIRT: Nanosprings:Exploring Mechanics at the Nanoscale - $1,530,971
Submitted: November, 2003
Agency: NSF
Status: Pending

Title: Center for Advanced Nanomaterials and Nanodevices - $1,021,300
Submitted: November, 2003
Agency: Idaho State Board of Education
Status: Pending

Title: Magnetic Random Access Memory ~ $3,000,000 over three cycles (co-PI)
Submitted: 2000,2001,2002
Agency: Office of Naval Research
Status: Awarded for three consecutive years

Title: Barium Ferrite Thick Films ~ $3,000,000 over three cycles (co-PI)
Submitted: 2002,2003,2004
Agency: Office of Naval Research
Status: Awarded for three consecutive years

COLLABORATORS (Within the past 48 months):

Gelsomina DeStasio, University of Wisconsin-Madison
Grant Norton, Washington State University
J. McHale, University of Idaho (Chemistry)
Terry M. Tritt, Clemson University
Cliff Olson, Ames Iowa Laboratory
Jeffrey Cutler, Canadian Synchrotron Center, Canada
Hartmut Hoscht, Synchrotron Radiation Center, Wisconsin
Brian Justus, Naval Research Laboratory
Armand Rosenberg, Naval Research Laboratory
Rudy Benz, ITT Industries, Roanoke, VA

Y. K. Hong, University of Idaho (Materials Engineering)
R. Ruoff, Northwestern University
J. J. Jiao, Portland State University