

**CURRICULUM VITAE**

**Name:**            **Shuvo Roy**

**Position:**        Associate Professor, Step II  
Department of Bioengineering and Therapeutic Sciences  
School of Pharmacy

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**EDUCATION:**

|           |   |       |   |
|-----------|---|-------|---|
| 1988-92   | Mount Union College, Alliance, OH                     | B.S.  | <i>Magna Cum Laude</i> ,<br>Physics, Mathematics,<br>and Computer Science |
| 1992-95   | Case Western Reserve University                       | M.S.  | Electrical Engineering<br>and Applied Physics                             |
| 1995-2001 | Case Western Reserve University<br>(Mehran Mehregany) | Ph.D. | Electrical Engineering<br>and Computer Science                            |

**PRINCIPAL POSITIONS HELD:**

|           |   |                        |   |
|-----------|---|------------------------|---|
| 1998-2002 | Cleveland Clinic                        | Project Staff          | Department of<br>Biomedical<br>Engineering                  |
| 2002-08   | Cleveland Clinic                        | Assistant Staff        | Department of<br>Biomedical<br>Engineering                  |
| 2008-now  | University of California, San Francisco | Associate<br>Professor | Department of<br>Bioengineering and<br>Therapeutic Sciences |

**OTHER POSITIONS HELD CONCURRENTLY:**

|           |                                 |                              |   |
|-----------|---------------------------------|------------------------------|---|
| 1998-2008 | Cleveland Clinic                | Co-Director                  | BioMEMS Laboratory  |
| 2000-2008 | Cleveland Clinic                | Faculty                      | Spine Research Laboratory   |
| 2001-2008 | Cleveland State University      | Assistant Professor          | Applied Biomedical Engineering Program  |
| 2001-2008 | Case Western Reserve University | Clinical Assistant Professor | Department of Electrical Engineering and Computer Science                     |
| 2006-2008 | Case Western Reserve University | Assistant Professor          | Department of Molecular Medicine, Cleveland Clinic Lerner College of Medicine |
| 2009-now  | Cleveland Clinic                | Adjunct Associate Staff      | Departments of Nephrology and Biomedical Engineering                          |

**HONORS AND AWARDS:**

- 1989 William and Burdella Carl Mathematics Award, Mount Union College
- 1992 Senior Physics Prize, Mount Union College
- 1998 Ruth Barber Moon Graduate Student Award, Case Western Reserve University
- 1999 Top 40 under 40, Crain's Cleveland Business
- 2001 Clinical Translation Award, BioMEMS and Biomedical Nanotechnology World Meeting
- 2003 MIT TR100 Award, Top 100 Young Innovators, Technology Review Magazine
- 2004 NASA Group Achievement Award, Harsh Environment MEMS
- 2004 Ribbon Award, Outstanding Symposium Paper, MRS Fall Meeting
- 2005 Who's Who in Biotechnology, Crain's Cleveland Business
- 2005 Cleveland Clinic Innovator Award
- 2006 Mentor Recognition Award, Cleveland Clinic Science Internship Program
- 2007 Cleveland Clinic Innovator Award
- 2008 Thomas G. Orr Memorial Lectureship, Southwestern Surgical Congress
- 2009 Biotech Humanitarian Award Finalist, Biotechnology Industry Organization
- 2009 2009 Images of the Year Selection, Biomaterials Journal

**KEYWORDS/AREAS OF INTEREST:**

**Medical Applications of MEMS and Nanotechnology:** Minimally Invasive Surgical Tools; Wireless Physiological Monitors; Portable Diagnostics; Tissue Engineering Substrates; Artificial Organs; Controlled Drug Delivery; High Resolution Ultrasonic Imaging

**PROFESSIONAL ACTIVITIES**

**PROFESSIONAL ORGANIZATIONS**

Memberships

1996-now, IEEE (Institute of Electrical and Electronics Engineers)

### Service to Professional Organizations

#### Advisory Role:

|          |                                 |                         |
|----------|---------------------------------|-------------------------|
| 2003     | Glennan Microsystems Initiative | Steering Committee      |
| 2003-now | Nano-Network                    | Founder, Advisory Board |

#### Meeting Organization:

|         |   |  |
|---------|---|--|
| 2000    | Coventor Workshop on Design Modeling of BioMEMS                               | Organizer and Host   |
| 2002/04 | 4 <sup>th</sup> & 6 <sup>th</sup> Annual International Symposium on BioMEMS   | Conference Chairperson   |
| 2003    | 4 <sup>th</sup> Annual BioMEMS and Nanotech World Meeting                     | Scientific Advisory Board & Session Chair – Clinical Applications, Applying MEMS to Medicine |
| 2004    | 5 <sup>th</sup> Annual BioMEMS and Nanotech World Meeting                     | Scientific Advisory Board & Session Chair – Minimally Invasive Medical Technology            |
| 2004    | 2004 BMES Annual Fall Meeting   | Session Chair – From the Nano- to the Micro- Scale in BME                                    |
| 2004    | The Cleveland Clinic NanoMedicine Summit                                      | Director & Principal Organizer   |
| 2004    | NCI Cancer Nanotechnology Symposium   | Chairperson of Steering Committee  |
| 2005    | Ohio Nanotechnology Summit  | Chairperson (Biomedicine) & Conference Steering Committee                                    |
| 2006    | Ohio Nanotechnology Summit  | Conference Steering Committee  |
| 2006    | ASME 2006 Summer Bioengineering Conference                                    | Session Chairperson - MEMS   |
| 2006    | CIMTEC 2006, 4 <sup>th</sup> Forum on New Materials                           | International Advisory Board – Biomedical Applications of Nano Technologies Symposium        |
| 2006    | Materials, Medicine, and Nanotechnology Summit                                | Co-Director & Principal Organizer  |
| 2008    | Materials and Processes for Medical Devices                                   | Co-Chairperson of Organizing Committee   |
| 2008    | Cleveland NanoMedicine Summit: Nanoparticles for Diagnostics and Therapeutics | Conference Organizing Committee  |

### **SERVICE TO PROFESSIONAL PUBLICATIONS:**

|          |  |
|----------|--|
| 2001     | Guest Editor, Biomedical Microdevices                      |
| 2002-now | Thematic Section Editor, Biomedical Microdevices           |
| 2003-now | Editorial Board, Sensors and Materials                     |
| 2005-now | Associate Editor, Editorial Board, Biomedical Microdevices |

1999-now

referee for Applied Physics Letters (6 papers in past 5 years), Biomedical Microdevices (20 papers in the past 5 year), Tissue Engineering (5 papers in past 4 years), Sensors and Materials (4 papers in past 4 years), Langmuir (3 papers in past 3 years), Nano Letters (2 papers in past 3 years), Macromolecular Bioscience (2 papers in past 5 years), Journal of Microelectromechanical Systems (1 paper in past 1 year), Journal of Membrane Science (2 paper in past 2 year), Journal of Neuroscience Methods (1 paper in past 5 years), Biotechnology and Bioengineering (1 paper in past 5 years), Journal of Biomaterials Science: Polymer Edition (1 paper in past 3 years), IEEE Spectrum (1 paper in past 5 years), Acta Biomaterialia (1 paper in the past 1 year), Journal of Medical Devices (2 papers in the past 1 year), Sensors and Actuators, (1 paper in the past 1 year)

## **INVITED PRESENTATIONS**

### **INTERNATIONAL**

BioMEMS and Biomedical Nanotechnology WORLD; Columbus, OH, 2000 (invited talk); Columbus, OH, 2001 (invited talk)  
International Vacuum Congress; San Francisco, CA, 2001 (invited talk)  
ASME 2006 Summer Bioengineering Conference; Amelia Island, FL, 2006 (plenary talk)  
Gordon Research Conference; New London, CT, 2006 (platform)  
Inauguration of Joint Biomedical Engineering Program between Ghent University and Free University of Brussels, Ghent, BELGIUM, 2007 (keynote)  
Poltzer Society Meeting, Cleveland, OH, 2007 (keynote)  
Southwest Surgical Congress Meeting, Acapulco, MEXICO 2008 (keynote)  
AVS International Symposium, Boston, MA, 2008 (invited talk)  
Endovascular Surgery - Bringing Basic Science to Clinical Practice, Stockholm, Sweden, 2009 (invited talk)  
Transducers 2009, Denver, CO 2009 (invited talk)  
World Molecular Engineering Network Twentieth Annual Meeting on Structural Biology, Cabo San Lucas, Mexico 2010 (invited talk)

### **NATIONAL**

BioMEMS; Sunnyvale, CA, 2001 (invited talk); Boston, 2002 (invited talk); Boston, 2004 (invited talk)  
NASS Spring Meeting; Boca Raton, FL, 2004 (invited talk)  
Conference-Workshop on Strategic Research to Enable NASA's Exploration Missions; Cleveland, OH, 2004 (invited talk)  
NNI Grand Challenge Workshop; Palo Alto, CA, 2004 (invited talk)  
ASAIO Annual Conference, Washington, DC, 2005 (invited talk); San Francisco, CA 2008 (plenary talk)  
ASEIO Annual Convention, Cleveland, OH, 2005 (invited talk)  
Society of Neurological Surgeons, Durham, NC, 2006 (invited talk)  
NSF Workshop on Wearable and Implanted Systems for Health Monitoring and Diagnostics, Arlington, VA, 2006 (invited talk)  
OMTEC 2007, Chicago, 2007 (invited talk)  
Glaucoma Summit, San Francisco, 2009 (invited talk)  
Bioengineering and Therapeutic Sciences Symposium, San Francisco, 2010 (invited talk)

talk)

University of California, Berkeley, Department of Bioengineering Seminar, 2010  
(invited talk)

## PROFESSIONAL MEDIA FEATURES

- 1999 Crain's Cleveland Business, "The Goal – Inside Out Surgery: Clinic Researchers Work on Smart Catheter Parts"  
DesignFax, "MEMS and Micromachining in the New Millennium: Biomedical Applications Aid Surgery, Diagnosis, Drug Delivery, and More"
- 2001 Small Times, "Doctors Find Faster Way to Stimulate Bone Growth"  
Small Times, "Buckeye State is Going Biotech to Create New Base"  
Small Times, "Smarter Tools Will Help Neurosurgeons Work More Accurately, Researchers Say"
- 2002 Northern Ohio Live, "Getting Small"  
Crain's Cleveland Business, "Local Research May Be the Next Line of Defense"  
Science, "Can Sensors Make a Home in the Body"
- 2003 Preclinica, "BioMEMS Comes to Life"  
NBC Wall Street Journal Report, "2003 Top Innovators"  
Nanobiotech News, "BioMEMS Applications Move from Concept to Reality"  
Technology Review, "Biotech + Medicine: The Convergence of Biology with Computing and Nanotechnology is Yielding Safer and More Effective Medicines"
- 2004 R&D Magazine, "Medical Applications Adopt MEMS Technology"  
MD News, "Nanomedicine at The Cleveland Clinic: Exploring the Big Potential of Tiny Technology"  
WDOK FM 104.1, "Nanotechnology"  
The Plain Dealer, "Tiny Science Expects to Reap Big Advances: Putting Heads Together on a Molecular Level"  
WCPN FM 90.3 (NPR), "Small Technology with a Big Impact"
- 2005 PBS Newshour with Jim Lehrer, "Women in Science"  
Crain's Cleveland Business, "Startup Senses a Need for Orthopedic Detection Device"  
Orthopedics This Week, "OrthoMEMS-NASA and Cleveland Clinic Team Up for Space Age Orthopedic Implants"
- 2006 Crain's Cleveland Business, "Summit to Bring Together Physicians, Engineers"  
Technology Review (online), "Dialysis Unplugged: Will nano-engineered implants set kidney patients free?"  
WCPN FM 90.3 (NPR), "Nanotechnology Brings Big Change"  
MPMD: Materials and Processes for Medical Devices, "Biomedical Microdevices at the Cleveland Clinic"
- 2007 Los Angeles Times, "The Next Generation of Artificial Kidneys"
- 2010 PBS Newshour, "For Scientists, Collaborative Efforts Could Speed Medical Advances"  
Discover Magazine, "Researchers Plan to Build the World's First Implantable, Mechanical Kidney"  
ABC 7 News, "Artificial kidneys may replace dialysis treatments"  
KTVU TV Channel 2 News, "Scientists Unveil Revolutionary Artificial Kidney"  
Yahoo! News, "UCSF Unveils Model for Implantable Artificial Kidney to Replace Dialysis"  
CNET.com, "Are the days of kidney dialysis numbered?"  
Popular Science – Online, "Researchers Announce First Implantable Artificial Kidney Prototype"

**GOVERNMENT and OTHER PROFESSIONAL SERVICE:**

|           |   |                                    |
|-----------|---|------------------------------------|
| 2001      | US Civilian Research and Development Fund | Grant Reviews                      |
| 2001-2004 | NIH/NCRR                                  | Study Section                      |
| 2002-now  | Glennan Microsystems, Inc.                | Board Member                       |
| 2003-now  | NIH/NIBIB                                 | Study Section                      |
| 2003-now  | National Science Foundation               | Grant Reviews                      |
| 2004      | Siemens Westinghouse Competition          | National Finals Judge              |
| 2010      | Nanoscale Science and Engineering Center  | External Scientific Advisory Board |

**UNIVERSITY AND PUBLIC SERVICE****UNIVERSITY SERVICE**CLEVELAND CLINIC – LERNER RESEARCH INSTITUTE

2003-2008 Communications Committee: Member (2003-2005) Chairperson (2005-now)

OHIO STATE UNIVERSITY – NSF CENTER FOR AFFORDABLE NANOENGINEERING OF POLYMERIC BIOMEDICAL DEVICES

2006-now Scientific Evaluation Board: Member

CLEVELAND CLINIC – CLEVELAND CLINIC MAGAZINE

2008 Advisory Board: Member

CLEVELAND STATE UNIVERSITY – DEPARTMENT OF CIVIL ENGINEERING:

2008-now Visiting Committee: Member

UNIVERSITY OF CALIFORNIA, SAN FRANCISCO – JOINT GRADUATE GROUP IN BIOENGINEERING:

2008-now Executive Committee: Member

UNIVERSITY OF CALIFORNIA, SAN FRANCISCO – SCHOOL OF PHARMACY

2008-now Faculty Council: Member

UNIVERSITY OF CALIFORNIA, SAN FRANCISCO – DEPARTMENT OF BIOENGINEERING AND THERAPEUTIC SCIENCES

2009-now Faculty Search Committee: Member

UNIVERSITY OF CALIFORNIA, SAN FRANCISCO – GRADUATE PROGRAM IN PHARMACEUTICAL SCIENCES AND PHARMACOGENOMICS

2009-now: Member

**TEACHING and MENTORING**

FORMAL SCHEDULED CLASSES FOR CASE WESTERN RESERVE UNIVERSITY STUDENTS:

| Sem  | Academic Yr | Course Title            | Teaching Contribution | Units | Class Size |
|------|-------------|-------------------------|-----------------------|-------|------------|
| Fall | 2001-2002   | Biomedical Microdevices | instructor            | 3     | 10         |

FORMAL SCHEDULED CLASSES FOR CLEVELAND STATE UNIVERSITY STUDENTS:

| Sem  | Academic Yr | Course Title | Teaching Contribution | Units | Class Size |
|------|-------------|--------------|-----------------------|-------|------------|
| Spr. | 2003-2004   | BioMEMS      | instructor            | 3     | 13         |

FORMAL SCHEDULED CLASSES FOR UNIVERSITY OF CALIFORNIA, SAN FRANCISCO STUDENTS:

| Sem  | Academic Yr | Course Title                                   | Teaching Contribution | Units | Class Size |
|------|-------------|--|-----------------------|-------|------------|
| Spr. | 2009-2010   | SOM Introduction to Human Biology and Medicine | guest lecturer        | 3     |            |

PREDOCTORAL STUDENTS SUPERVISED OR MENTORED:

| Dates     | Name                  | Program or School  | Role  | Current Position   |
|-----------|-----------------------|--|---|--|
| 2003      | Paul Bixenstine       | Shaker Heights High School, high school student                  | Co-supervised laboratory work on ultrasound transducer  | Undergraduate Student - Brown University                   |
| 2002-2005 | Charlie Blaha         | Dennison University, University of Toledo, undergraduate student | Supervised undergraduate research projects on spine biomechanics and tissue engineering scaffolds | Scientist - Specialized Vascular Technologies              |
| 2006      | Grant Cathcart        | Shaker Heights High School, high school student                  | Co-supervised summer work on ultrasound transducers   | Undergraduate Student - Rice University                    |
| 2003-now  | Chaitanya Chandrana   | Cleveland State University, graduate student                     | Doctoral advisor on ultrasound transducers  | Doctoral Candidate - Cleveland State University            |
| 1999      | Christine Chevalier   | University of Dayton, undergraduate student                      | Supervised undergraduate research project on blood coagulation sensor                             | Engineer - Analex Corporation                              |
| 2003-2006 | Maddy Coquillette     | Hathaway Brown School, high school student                       | Supervised research project on spine biomechanics   | Undergraduate Student - Yale University                    |
| 2006-2007 | Abby Eldridge         | Rensselaer Polytechnic Institute, undergraduate student          | Supervised undergraduate research project on surface modification                                 | Graduate Student - Rensselaer Polytechnic Institute        |
| 2001-2008 | Lisa Ferrara          | Cleveland State University, graduate student                     | Doctoral advisor on spine biomechanics  | Founder - Orthokinetic Technologies                        |
| 2005      | Levi Frolich          | Fuchs Mizrahi School, high school student                        | Co-supervised summer work on ultrasound transducers   | Undergraduate Student - Bar-Ilan University                |
| 2004      | Aseem Garg            | St. Edward High School, high school student                      | Supervised summer work on bioMEMS   | Undergraduate Student - Washington University in St. Louis |
| 2004-2005 | Morgan Grossman-Mckee | Shaker Heights High School, high school                          | Supervised research project on cell growth  | Undergraduate Student - Washington                         |

|           |                      |   |  |   |
|-----------|----------------------|---|--|---|
|           |                      | student   | kinetics   | University in St. Louis                                   |
| 2002      | Matthew Immerman     | Shaker Heights High School, high school student   | Co-supervised summer work on bioMEMS                                   | Undergraduate Student - Brown University                  |
| 2004-now  | Eun Jung Kim         | Cleveland State University, graduate student      | Doctoral advisor on tissue engineering scaffolds                       | Doctoral Candidate - Cleveland State University           |
| 2007      | Laney Kuenzel        | Hathaway Brown School, high school student        | Supervised research project on drug delivery microneedles              | Undergraduate Student - Stanford University               |
| 2002-2003 | Jeff Magistrelli     | Case Western Reserve University, graduate student | Master's thesis advisor on membrane transport characterization         | Engineer - Firestone Polymers                             |
| 2001      | Emily Marcinkevicius | Hathaway Brown School, high school student        | Supervised research project on bioMEMS                                 | Graduate Student - Memorial Sloan-Kettering Cancer Center |
| 2001-2005 | Alvaro Mata          | Cleveland State University, graduate student      | Doctoral advisor on tissue engineering scaffolds                       | Postdoctoral Fellow - Northwestern University             |
| 2001-2002 | Rushabh Modi         | Case Western Reserve University, graduate student | Master's thesis advisor on ultrasound transducers                      | Engineer - Siemens Medical                                |
| 2002-2008 | Pulak Nath           | Cleveland State University, graduate student      | Doctoral advisor on microfluidic biochip system                        | Postdoctoral Fellow - Los Alamos National Laboratory      |
| 2006      | Steve Pennybaker     | Newbury High School, high school student          | Supervised summer work on drug delivery microneedles                   | Senior Student - Newbury High School                      |
| 2002-2004 | Rachel Rosenblum     | Case Western Reserve University, graduate student | Master's project advisor on membrane fabrication process               | Doctoral Candidate - Case Western Reserve University      |
| 1999-2000 | Christina Saikus     | Hathaway Brown School, high school student        | Co-supervised laboratory work on bioMEMS                               | Medical Student - Emory University                        |
| 2005      | Dusty Schroeder      | Bucknell University, undergraduate student        | Supervised undergraduate research project on cell growth kinetics      | Graduate Student - University of Texas at Austin          |
| 2004-2007 | Ross Smith           | Case Western Reserve University, graduate student | Master's thesis advisor on membrane transport characterization         | Doctoral Candidate - Case Western Reserve University      |
| 2001-2003 | Elena Udovina        | Hathaway Brown University, high school student    | Supervised research project on membrane characterization               | Undergraduate Student - Harvard University                |
| 2003      | Mike Vanderboom      |   | Supervised summer work on bioMEMS                                      | <i>unknown</i>  |
| 2002      | Emiko Vaughn         | Beaumont School, high school student              | Supervised research project on surface modification                    | Undergraduate Student - Miami University                  |
| 2005      | Teal Wurm            | University of Cincinnati, undergraduate student   | Co-supervised undergraduate research project on ultrasound transducers | Graduate Student - University of Minnesota                |

|          |                          |  |                                    |   |
|----------|--------------------------|--|------------------------------------|---|
| 2009     | Lalitha Muthusubramaniam | University of California, San Francisco, graduate student  | Supervised summer rotation project | Graduate Student – University of California, San Francisco  |
| 2009     | Rohit Nalamasu           | University of California, San Diego, undergraduate student | Supervised summer internship       | Undergraduate Student – University of California, San Diego |
| 2009     | Mozziyar Etemadi         | University of California, San Francisco, MD/PhD Student    | Supervised summer rotation project | Medical Student – University of California, San Francisco   |
| 2009     | Jonathan Sockolosky      | University of California, San Francisco, graduate student  | Supervised research rotation       | Graduate Student – University of California, San Francisco  |
| 2009-now | Augusto Tentori          | University of California, San Francisco, graduate student  | Graduate Student Advisor           | Graduate Student – University of California, San Francisco  |
| 2009-now | Erh-Chia Yeh             | University of California, San Francisco, graduate student  | Graduate Student Advisor           | Graduate Student – University of California, San Francisco  |
| 2010     | Neel Shah                | University of California, Berkeley, graduate student       | Supervised graduate research       | Graduate Student – University of California, Berkeley       |
| 2010     | Torin Yeager             | University of California, San Francisco, graduate student  | Supervised research rotation       | Graduate Student – University of California, San Francisco  |

**POSTDOCTORAL FELLOWS AND RESIDENTS DIRECTLY SUPERVISED OR MENTORED:**

| Dates     | Name                | Fellow   | Faculty Role                             | Current Position                                 |
|-----------|---------------------|--|--|--|
| 1998-2002 | William Fissell, MD | Resident - University Hospitals of Cleveland<br>Nephrology Fellow - University of Michigan | Research Supervision,<br>Career Guidance | Associate Staff - Cleveland Clinic               |
| 2005-2006 | Matt Johnston, PhD  | Postdoctoral Fellow - Cleveland Clinic   | Research Supervision                     | Scientist - Gebauer Company                      |
| 2004-2008 | Tao Pan, PhD        | Research Engineer - Cleveland Clinic   | Research Supervision                     | Research Engineer – Cleveland Clinic             |
| 2001-2005 | Jim Talman, PhD     | Research Engineer - Cleveland Clinic   | Research Supervision                     | Patent Examiner - US Patent and Trademark Office |
| 2009-now  | Rachel Lowe, PhD    | Postdoctoral Fellow  | Research Supervision                     | ---  |
| 2009-now  | Rishi Kant, PhD     | Postdoctoral Fellow  | Research Supervision                     | ---  |
| 2010-now  | Eun Jung Kim, PhD   | Postdoctoral Fellow  | Research Supervision                     | ---  |

**FACULTY MENTORING**

FACULTY MENTORED:

| Dates     | Name                  | Position while Mentored  | Mentoring Role                       | Current Position  |
|-----------|-----------------------|--|--------------------------------------|---|
| 2003-now  | William Fissell, MD   | Lecturer (Medicine), Assistant Professor (Medicine) - University of Michigan | Grant Reviews, Research Collaborator | Associate Staff (Nephrology), Director of Renal Nanotechnology Laboratory (Biomedical Engineering) - Cleveland Clinic |
| 1998-now  | Aaron Fleischman, PhD | Project Staff, Assistant Staff - Cleveland Clinic                            | Grant Reviews, Research Collaborator | Assistant Staff, Co-Director of BioMEMS Laboratory (Biomedical Engineering) - Cleveland Clinic                        |
| 2001-2004 | Raj Shekhar, PhD      | Project Staff - Cleveland Clinic   | Grant Reviews                        | Assistant Professor (Diagnostic Radiology) - University of Maryland in Baltimore                                      |
| 2002-2005 | Geoff Vince, PhD      | Assistant Staff - Cleveland Clinic   | Grant Reviews, Research Collaborator | Vice-President of Clinical Affairs - Volcano Corporation  |
| 2004-2007 | Steve William, PhD    | Project Staff - Cleveland Clinic   | Grant Reviews                        | Project Staff (Biomedical Engineering) - Cleveland Clinic   |

**OTHER VISITING FACULTY SUPERVISED:**

1999 Gerry Neudeck, PhD Purdue University

**TEACHING AIDS:**

Developed syllabus, lectures, hand-outs, and group website for a semester-long course on biomedical applications of MEMS technology; class was offered twice for advanced undergraduate and graduate students at Case Western Reserve University and Cleveland State University.

Developed syllabus, lecture materials, and hand-outs for class on minimally invasive biomedical MEMS technology, which was part of an annual short course on BioMEMS sponsored by ASME (American Society of Mechanical Engineers); class was adopted for 3 years.

**OTHER:**

See book chapters, Introduction to MEMS and MEMS and Neurosurgery, which are listed under “Non-Peer Reviewed Publications and Other Creative Activities”; these materials are used by neurosurgery and spine postdoctoral and clinical fellows at the Cleveland Clinic.

Instructor for Corning Future Opportunities Innovation Workshop, which explored potential market introduction and growth opportunities for Corning, Inc.

Instructor for CMP-MIC short course on microfabrication of medical devices, which was attended by semiconductor fabrication engineers with specialization in chemical-mechanical polishing.

### **SUMMARY OF TEACHING HOURS:**

2007-08: 165 total hours of teaching (including preparation). Formal class or course teaching hours: 15 hours Informal teaching hours: 150 hours Mentoring hours

2008-09: 150 total hours of teaching (including preparation). Formal class or course teaching hours: 10 hours Informal teaching hours: 140 hours Mentoring hours

2009-10: Total anticipated hours of teaching: 180 hours (including preparation). Formal class or course teaching hours: 10 hours Informal teaching hours: 150 hours Mentoring hours.

### **TEACHING NARRATIVE**

I have participated in the redesign and teaching of BPS 113 course, which will be offered to 1<sup>st</sup> year UCSF clinical pharmacy students in Spring 2010. In addition, I am designing a course on medical device design for 2010-2011 for graduate bioengineering and professional students.

I have designed and taught a semester-long course on biomedical applications of MEMS for advanced undergraduate and graduate students at Case Western Reserve University and Cleveland State University, both of which are located near the Cleveland Clinic. Typically, 10-15 students enrolled from various engineering departments, and with varying levels of background knowledge of MEMS. Therefore, I sectioned the course into three components - review of fundamental technologies, analysis of prototype bioMEMS devices, and a term paper project. I used a mixed model of problem based learning (PBL) and traditional instruction to achieve a balance between transmission of formal knowledge and development of core skills such as inquiry, problem solving, and collaboration.

I have also designed and taught short courses ranging from half-day to 4 days in conjunction with professional societies and corporate continuing education offices. These courses are customized to the audience backgrounds and needs. Typically, the courses have been targeted to either practicing engineers interested in learning about challenges that must be overcome for successful medical device development, or clinicians interested in developing MEMS solutions to existing medical problems. For both groups, I offered an overview of state-of-the-art in MEMS technology, and then engaged the attendees through interactive discussions on specific problems that overlap with their interests and background.

## **RESEARCH AND CREATIVE ACTIVITIES**

### **RESEARCH AWARDS AND GRANTS**

#### CURRENT

Translational Technology Development Award      02/01/11-06/30/12      as needed

Clinical and Translational Science Institute, UCSF      \$10,000 (TDC)

*Reconstruct of vertebral endplate using biomedical microelectromechanical systems (bioMEMS) and microfabrication related technologies MEMS and nanotechnology.*

Role: PI  
OVERLAP: None

|   |                      |
|---|----------------------|
| R01 EB008049 (PI)   | 9/30/2007-8/31/2011  |
| NIH/NIBIB   | \$871,806            |
| Miniaturized Implantable Renal Assist Device for<br>Total Renal Replacement Therapy | \$2,599,296          |
| <br>  |                      |
| Bridging the Gap Award (PI)   | 01/01/10-12/31/10    |
| Private Foundation  | \$100,000            |
| Development of a wearable, hemofiltration device<br>for renal replacement.          |                      |
| <br>  |                      |
| 1 P50 FD003793-01 (Co-I)  | 09/25/09-07/31/11    |
| Food & Drug Administration Pediatric Device<br>Consortia Grant Program              | 346,550              |
| UCSF Pediatric Device Consortium  | 670,267              |
| <br>  |                      |
| W81XWH-05-2-0010 (Co-PI)  | 6/1/2005 – 8/31/2010 |
| DoD/USAMRMC   | \$50,000             |
| Nanofabricated Bioartificial Kidney   | \$250,000            |

### PENDING

|   |                     |
|---|---------------------|
| 1U01EB012472 (PI)   | 9/01/2010-8/31/2015 |
| NIH/NIBIB   | \$2,103,686         |
| Miniaturized Implantable Renal Assist Device for<br>Total Renal Replacement Therapy | \$10,292,356        |

### PAST

|  |                         |
|--|-------------------------|
| (PI)   | 1/01/1999 - 6/20/1999   |
| Cleveland Advanced Manufacturing Program,<br>Microfabricated Filters and Cutting Tools | \$17,000<br>\$17,000    |
| <br>   |                         |
| R43 HL062733 (Co-Investigator)   | 05/15/1999 - 11/30/2000 |
| NIH/SBIR-Phase I   | \$22,150                |
| Miniature, Implantable Fiber-Optic Pressure Sensor                                     | \$22,150                |
| <br>   |                         |
| (Co-PI)  | 08/15/1999 - 06/30/2000 |
| Ohio Board of Regents  | \$243,000               |
| Ohio MicroMD: The Ohio BioMEMS Consortium<br>on Medical Therapeutic Devices            | \$243,000               |
| <br>   |                         |
| (Co-PI)  | 7/1/1999 - 6/30/2003    |

|   |                        |
|---|------------------------|
| NASA  | \$98,490               |
| Micromachined Ultrasonic Transducers For Minimally Invasive Imaging   | \$393,960              |
| (Co-PI)   | 7/1/1999 - 6/30/2003   |
| NASA  | \$96,141               |
| Miniature Drug Delivery Systems for Minimally Invasive Therapy  | \$384,564              |
| (PI)  | 7/1/2000 - 12/31/2000  |
| iMEDD, Inc.   | \$10,340               |
| Fabrication of Nanomembranes  | \$10,340               |
| (Consultant Co-PI)  | 7/15/2000 - 12/31/2000 |
| Whitaker Foundation   | \$15,833               |
| Micromachined Biocapsule Membranes  | \$15,833               |
| BAA 00-011 SymBioSys (Co-PI)  | 9/1/2000 - 6/30/2002   |
| DARPA   | \$186,002              |
| Experimental and Theoretical Development of Bio-Fluid Transport Models through Nano- and Micro-fluidic Components | \$325,503              |
| (Co-PI)   | 10/1/2000 - 9/30/2002  |
| NASA  | \$33,507               |
| Evaluation of MEMS Materials of Construction for Implantable Medical Applications                                 | \$67,114               |
| 01-060 (PI)r  | 7/1/2001 - 6/30/2004   |
| Ohio Third Frontier Action Fund   | \$369,930              |
| MEMS Technology Platform for Implantable Medical Applications   | \$739,860              |
| (PI)  | 5/1/2002 - 4/30/2005   |
| NASA  | \$168,313              |
| Controlled-Release Microsystems for Pharmacological Agent Delivery  | \$477,689              |
| R01 HL 069094 (Co-Investigator)   | 1/1/2002 – 12/31/2007  |
| NIH/NHLBI   | \$499,000              |
| High Frequency Nonlinear Acoustic Intravascular Imaging   | \$2,494,583            |
| (PI)  | 1/1/2003 - 9/30/2003   |
| Rockefeller Brothers Fund   | \$23,150               |
| Growth of Connective Tissue Progenitor Cells on Micro-Textured Surfaces for Enhanced Bone Tissue Engineering      | \$23,150               |

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| R43 HL 074652 (Co-Investigator)                           | 9/1/2003 - 8/31/2004  |
| NIH/SBIR-Phase I  | \$21,568              |
| Ultrasonic Microtransducer for Intravascular Imaging      | \$21,568              |
| R21 EB 002285 (Co-Investigator)                           | 9/30/2003 - 5/31/2006 |
| NIH/NIBIB   | \$50,000              |
| BioMEMS Materials for Renal Tissue Engineering            | \$100,000             |
| R21 EB 003272 (PI)  | 9/12/2003 - 8/31/2006 |
| NIH/NIBIB   | \$150,000             |
| Microneedle Array for Catheter Drug Delivery              | \$275,000             |
| W81XWH-04-1-0520 (Co-PI)                                  | 5/18/2004 - 6/30/2008 |
| DoD/USAMRMC   | \$378,830             |
| Portable Biochip for Rapid Detection of Biowarfare Agents | \$1,086,835           |
| (PI)  | 5/1/2005 - 12/31/2007 |
| OrthoMEMS, LLC  | \$13,000              |
| Wireless Pressure Sensor Demonstration                    | \$43,846              |
| (PI)  | 8/1/2005 - 6/30/2007  |
| NASA  | \$62,405              |
| High Resolution Portable Ultrasonic Imaging System        | \$124,810             |
| R43 NS 052939 (Co-Investigator)                           | 9/15/2005 - 6/30/2008 |
| NIH/NINDS   | \$25,000              |
| Ambulatory System for Hydrocephalus Shunt Monitoring      | \$49,460              |
| (Co-Investigator)   | 7/1/2005 - 6/30/2008  |
| Ohio BRTT Partnership                                     | \$1,212,121           |
| Clinical Tissue Engineering Center (CTEC)                 | \$3,636,364           |
| R43 HL084775 (Co-Investigator)                            | 9/30/2006 - 3/31/2008 |
| NIH/SBIR-Phase I  | \$14,154              |
| Micromachined Intravascular Ultrasound Transducer         | \$14,154              |
| 0750159 (Co-Investigator)                                 | 1/1/2007 - 6/30/2007  |
| NSF/SBIR-Phase I  | \$21,227              |
| Intravascular Drug Delivery using Microneedle Arrays      | \$21,227              |
| 0750218 (Co-Investigator)                                 | 1/1/2007 - 6/30/2007  |
| NSF/SBIR-Phase I  | \$19,785              |

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| Wireless Sensor for <i>In Vivo</i> Wireless Pressure Measurement | \$19,785              |
| NNC07QA84A84P-1A (PI)  | 1/1/2007 - 12/31/2007 |
| NASA/STTR-Phase I  | \$24,501              |
| Nanoporous Membrane for Medical Grade Water Generation           | \$24,501              |

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**NON-PEER REVIEWED PUBLICATIONS AND OTHER CREATIVE ACTIVITIES:**

## BOOK CHAPTERS

1. M. Mehregany and S. Roy, "Introduction to MEMS", in *Microengineering for Aerospace Systems*, H. Helvajian, Ed., Aerospace Press, Los Angeles, CA, USA, **1999**
2. S. Roy, L.A. Ferrara, A.J. Fleischman, and E.C. Benzel, "MEMS and Neurosurgery", in *Encyclopedia of BioMEMS and Bionanotechnology – Volume III: BioMEMS and Biomedical Nanotechnology*, T.A. Desai, S. Bhatia, and M. Ferrari, Eds., Springer, New York, NY, USA, **2006**
3. W.H. Fissell, S. Roy, A.J. Fleischman, and H.D. Humes, "Cell Therapy of Renal Failure", in *Cell Therapy*, D. Garcia-Olmo, J.M. Garcia-Verdugo, J. Alemany, and J.A. Gutierrez-Fuentes, Eds., McGraw-Hill, Madrid, SPAIN, **2008**
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## TECHNICAL REPORT

1. R.G. DeAnna, M. Mehregany, **S. Roy**, "Microfabricated ice-detection sensor", *NASA Technical Memorandum 107432*, and *Army Research Laboratory Technical Report ARL-TR-1355*, **1997**.

## PATENTS ISSUED OR PENDING (ALLOWED)

1. System for Measuring Intraocular Pressure of an Eye and a MEM Sensor for Use Therewith, A.J. Fleischman, S. Roy, and H. Lewis, US Patent 6,447,449 (2002)
2. MEMS-based Integrated Magnetic Particle Identification System, A.J. Fleischman, S. Roy, M. Zborowski, and J. Chalmers, US Patent 6,623,984 (2003)
3. Miniature Ultrasound Transducer, A.J. Fleischman, S. Roy, and G. Lockwood, US Patent 6,641,540 (2003)
4. Apparatus and Method for Monitoring a Condition inside a Body Cavity, S. Roy, K. Ouriel, and A.J. Fleischman, US Patent 6,682,490 (2004)
5. Apparatus and Method for Assessing Loads on Adjacent Bones, S. Roy, L.A. Ferrara, A.J. Fleischman, and E.C. Benzel, US Patent 6,706,005 (2004)
6. Intraocular Pressure Measurement System including Sensor Mounted in a Contact Lens, A.J. Fleischman, S. Roy, and H. Lewis, US Patent 6,749,568 (2004)
7. Microneedle Array Module and Method of Fabricating the Same, S. Roy and A.J. Fleischman, US Patent 6,790,372 (2004)
8. Apparatus and Method for Measuring Intraocular Pressure, A.J. Fleischman and S. Roy, US Patent 6,994,672 (2006)
9. Ultrafiltration Membrane, Device, Bioartificial Organ, and Methods, W.H. Fissell, H.D. Humes, S. Roy, and A.J. Fleischman, US Patent 7,048,856 (2006)
10. Intraocular Pressure Measurement System including a Sensor Mounted in a Contact Lens, A.J. Fleischman, S. Roy, and H. Lewis, US Patent 7,169,106 (2007)
11. Apparatus and Method for Assessing Loads on Adjacent Bones, S. Roy, L.A. Ferrara, A.J. Fleischman, and E.C. Benzel, US Patent 7,182,736 (2007)
12. Microneedle Array Module and Method of Fabricating the Same, S. Roy and A.J. Fleischman, US Patent 7,262,068 (2007)
13. Method and Apparatus for In Vivo Sensing, A.J. Fleischman, S. Roy, and J. Talman, US Patent 7,284,442 (2007)
14. Apparatus and method for assessing loads on adjacent bones, S. Roy, A.J. Fleischman, E.C.

- Benzel, and L.A. Ferrara, US Patent 7,491,179 (2009)
15. Ultrafiltration Membrane, Device, Bioartificial Organ, and Methods, W.H. Fissell, H.D. Humes, S. Roy, and A.J. Fleischman, US Patent 7,540,963 (2009)
  16. Method and apparatus for eddy current compensation in a radio frequency probe, J.R. Talman, A.J. Fleischman, B.L. Sauer, S. Roy, US Patent 7,771,351 (2010)
  17. Method and apparatus for determining a characteristic of an in vivo sensor. Talman; James R., Roy; Shuvo, Sauer; Brian L., Fleischman; Aaron J. US Patent 7,878,208 (2011)

## **OTHER CREATIVE ACTIVITIES**

### **CONFERENCE ABSTRACTS:**

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