Final Report for Period: 07/2010 - 06/2011 **Submitted on:** 07/06/2011

Principal Investigator: Baier, Robert E. **Award ID:** 0426355

Organization: SUNY Buffalo

Submitted By:

Baier, Robert - Principal Investigator

Title:

Industry/University Cooperative Research Center for Biological Surface Science

Project Participants

Senior Personnel

Name: Baier, Robert

Worked for more than 160 Hours: Yes

Contribution to Project:

Executive Director of the I/UCRC

Name: Jahan, M.

Worked for more than 160 Hours: Yes

Contribution to Project:

Site Director of I/UCRC site at The University of Memphis. Partial support from this project; major support from The University of Memphis.

Name: Meyer, Anne

Worked for more than 160 Hours: Yes

Contribution to Project:

Site director for I/UCRC Buffalo site.

Name: Zablocki, Edward

Worked for more than 160 Hours: No

Contribution to Project:

Evaluator for the I/UCRC, as required by NSF.

Name: Cipriano, Ramon

Worked for more than 160 Hours: Yes

Contribution to Project:

adjunct faculty - expert in aerosols and aerobiology

Name: Sugarman, Robert

Worked for more than 160 Hours: Yes

Contribution to Project:

adjunct faculty - expert in human factors research

Name: Meng, Hui

Worked for more than 160 Hours: No

Contribution to Project:

collaborating faculty - Dept. Mechanical & Aerospace Engineering

Name: Stephens, Lisa

Worked for more than 160 Hours: No

Contribution to Project:

collaborating communications specialist; Director of University at Buffalo's Distance Education & Videoconference Operations

Name: Llinas, James

Worked for more than 160 Hours: No

Contribution to Project:

Collaborating faculty; Dept. Industrial Engineering

Name: Woodward, Scott
Worked for more than 160 Hours: No
Contribution to Project:
collaborating Senior researcher (colleague of Hui Meng); Dept. Mechanical & Aerospace Engineering

Post-doc

Name: Sharab, Lina
Worked for more than 160 Hours: Yes
Contribution to Project:

Photodynamic Therapy (PDT)-Assisted Biofilm Removal from Biomaterials

In dental settings, as well as in other natural systems, plaque-forming microorganisms develop biofilms in which the microbes become protected via their own phenotypic changes and their polymeric exudates from disinfection by washes and antibiotics. Photodynamic Therapy (PDT) is variably effective against these microorganisms, depending on such factors as whether the bacteria are Gram positive or Gram negative, plaque age and thickness, and internal biofilm oxygen concentration. This investigation applied a novel combination of PDT and water-jet impingement techniques to Streptococcus mutans (ATCC strain 27351)-formed biofilms on commercially pure titanium (cpTi), to examine whether the detachment shear stress ?as a signature for the work required for removal of the biofilms?would be affected by prior PDT treatment independently from microbial viability. Biofilms were grown with and without sucrose addition to Brain Heart Infusion media, producing visibly thick films and nearly invisible thin films having the same numbers of culturable microorganisms, the thicker films having greater susceptibility to detachment by water-jet impingement. Colony-forming-unit (CFU) counts routinely correlated well with results from a spectrophotometric Alamar Blue (AB) assay, except at long incubation times when the AB reagents showed some autoreduction-induced color changes. Use of Methylene Blue (MB) as a photosensitizer (PS) for PDT of biofilms did not interfere with the AB assay, but did mask AB reduction spectral changes when employed with planktonic organisms.

It was discovered in this work that PDT-treated microbial biofilms, independently from starting or PS-influenced microorganism viability, were significantly ($p < 0.05$) and differentially delaminated and ultimately removed from their substrata biomaterials by the hydrodynamic forces of water-jet impingement. Control biofilms of varying thicknesses, not receiving PDT treatment, required between 144 and 228 dynes/cm2 of shear stress to delaminate from titanium while PDT-treated companion biofilms were removed at 90 to 140 dynes/cm2, depending on water flow rate. In comparison, it required only between 57 and 68 dynes/cm2 shear stress to separate microbial layers from within the exopolymer matrix of control biofilms, and between 39 and 51 dynes/cm2 to delaminate PDT-treated matrix sections of varying thickness biofilms, again depending on water flow rate. Multiple Attenuated Internal Reflection InfraRed spectra of identical biofilms, grown on germanium prisms having surface properties similar to those of cpTi, confirmed these differences in film-removal susceptibility for shear stresses as low as 10 dynes/cm2, and illustrated the PDT-induced preferential removal of predominantly the polysaccharide biofilm components. Scanning Electron Microscopy of Control and PDT-treated biofilms before and after water-jet impingement also confirmed these findings.

Trials with Photofrin as an alternative photosensitizer to MB showed lower effectiveness in suppressing bacterial viability but greater effectiveness, when exposed to light, in reducing biofilm cohesion. These results are consistent with proposals that PDT induces oxidative embrittlement and fragmentation of plaque/biofilm matrix biopolymers, allowing easier release by hydrodynamic (rinsing) forces.

Graduate Student

Name: Nagathan, Prashant
Worked for more than 160 Hours: No
Contribution to Project:
Mechanical Engineering graduate student who performed short-term projects on medical air sampling, etc; see section on Development (people)

Name: Guruswamy, Sanketh

Worked for more than 160 Hours: No

Contribution to Project:

Civil Engineering grad student who performed short-term projects on diesel exhaust sampling, etc; see section on Development (people)

Name: DeGeorge, Joseph

Worked for more than 160 Hours: No

Contribution to Project:

Biological Sciences grad student; volunteer in lab to learn about biosurfaces research; assisting with air sampling in School of Dental Medicine

Name: Chary, Mallika

Worked for more than 160 Hours: No

Contribution to Project:

Biomaterials grad student; completing thesis on glass fibers/particles in the lung (this was the focus of the I/UCRC's research when Mallika Chary began her research in the Biomaterials Graduate Program).

Name: Ridley, Marlon

Worked for more than 160 Hours: No

Contribution to Project:

Key graduate student working with Professor Jahan at The University of Memphis site. Also developing leadership skills in the Society For Biomaterials (U.S.). [See section on Contributions Beyond Science and Engineering]

Name: Durant, Jason

Worked for more than 160 Hours: No

Contribution to Project:

Graduate student working with Professor Jahan at The University of Memphis site. Recently defended M.S. thesis and received 2005 summer intership in the Pediatric Oncology Education program at St. Jude Hospital (Memphis).

Name: Gray, Jonathan

Worked for more than 160 Hours: No

Contribution to Project:

Grad student working with Professor Jahan at The University of Memphis. Currently volunteering at the St. Jude Hospital Medical Physics Department (Memphis).

Name: Lewis, Scott

Worked for more than 160 Hours: No

Contribution to Project:

Electron Spin Resonance studies for thesis research.

Name: Prindle, Jonathan

Worked for more than 160 Hours: Yes

Contribution to Project:

Major contributor to studies of safety and effectiveness of lubricating and cleaning/comfort solutions for contact lenses, supported by Industry funds from prior Member (Alcon Laboratories) of IUCRC Advisory Board. Now pioneering use of Infrared Microscopy for identification of fugitive particulate matter in tissue sections and biopsies.

Name: Ali, Rasha

Worked for more than 160 Hours: No

Contribution to Project:

Name: Alnoury, Arwa

Worked for more than 160 Hours: No

Contribution to Project:

Name: Alnowailaty, Yousef

Worked for more than 160 Hours: No
Contribution to Project:

Name: Andolina, Vincent
Worked for more than 160 Hours: No
Contribution to Project:

Name: Chodagiri, Shanthi
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: LaMastra, Michael
Worked for more than 160 Hours: No
Contribution to Project:

Name: Sah, Vasu
Worked for more than 160 Hours: No
Contribution to Project:

Name: Thirugnanam, Sakthi
Worked for more than 160 Hours: No
Contribution to Project:

Name: Hmiel, Corey
Worked for more than 160 Hours: Yes
Contribution to Project:
Strain-Induced Strengthening of Bioprosthetic Tissue in Physiologically Super-Saturated Calcium Phosphate Solution

It would be desirable to develop bioprosthetic devices that could replace damaged collagen-based connective tissues such as periodontal ligaments and joint tendons that show variable degrees of mineralization from their rigid hard-tissue insertions to their flexible central zones. Tanned bovine pericardium, when utilized in implanted bioprosthetic heart valves, has been found to slowly acquire such distributed bone-like calcium hydroxyapatite deposits, predominantly at regions of maximum strain, and it has been shown that this process can be significantly accelerated using super-saturated calcium phosphate solutions in laboratory apparatus. This investigation sought to examine the potential strengthening of tanned pericardial tissue strips when strained in room-temperature calcium phosphate solution, at 30X physiological concentration, as a first step toward fabrication of bone-bonding bioprosthetic ligaments and tendons. Preliminary trials explored the utility of oscillating (1-50Hz) vs constant strain, over variable (1-100 hours) times, as well as differential stress conditions for dogbone-shaped vs rectangular samples, concluding that application of 10% strain for 4 hour periods would best represent the attainable tensile strength changes when applied to 2mm-wide tanned pericardium strips immersed in the calcium phosphate solution. For these selected conditions, twenty-five experiments were done employing adjacent cut strips of tanned pericardium in sets of three for each trial: one strip as-received, prepared for surgical use; a second strip, placed into the solution container surrounding the tensile test grips, as a solution-exposure-only Control; and the third strip held at 10% strain for 4 hours at room temperature in the mineralization solution. Conventional tensile testing of all specimens was applied, producing these statistically significant results indicating preferential strengthening of the strain-held samples over the as-received and static immersion controls: Ultimate stress values for as-received pericardium = 6.92N +- xxx; for solution Control pericardium = 7.03N +-xxx; for 10% strained, solution-exposed pericardium = 7.64 +-xxx.

Specimens of each type were examined by Multiple Attenuated Internal Reflection Infrared (MAIR-IR) Spectroscopy for evidence of phosphate mineral uptake, by Scanning Electron Microscopy and Energy Dispersive x-ray(SEM/EDS) analysis for presence and location of possible calcium and phosphate deposits, by confocal Infrared Microscopy (IM) to visualize tissue fibrillar orientation with regard to the tensile force direction, and by conventional x-ray imaging to assess possible internal densification of the mineralization solution-incubated tissues. MAIR-IR revealed small amounts of preferential phosphate uptake into the strain-held tissue specimens, making it unlikely that their strength increase was due to calcium ion cross-linking alone. SEM/EDS showed

scattered superficial deposits of Calcium- and Phosphorus-rich nodules, with no evidence for periodicity or localization to regions of maximum strain. IM showed disorganized fibrous lamellae not well-oriented into the tensile direction, suggesting that more completely oriented collagenous substructures might obtain even greater strength increases. Standard x-ray imaging did not reveal significant tissue densification in any case, indicating that added calcium phosphate deposits were mostly superficial. Since increased temperature toward the physiologic value of 37C did trigger greater degrees of mineral precipitation from the calcium phosphate solution, the next planned strength-improvement trials will be at higher temperatures.

Name: Poon, Angela

Worked for more than 160 Hours: Yes

Contribution to Project:

Endotoxin Removal by Radio Frequency Gas Plasma (Glow Discharge)

Contaminants remaining on implantable medical devices, even following sterilization, include dangerous fever-causing residues of the outer lipopolysaccharide-rich membranes of Gram-negative bacteria such as the common gut microorganism E. coli. The conventional method for endotoxin removal is by Food & Drug Administration (FDA)-recommended dry-heat depyrogenation at 250C for at least 45 minutes, an excessively time-consuming high-temperature technique not suitable for low-melting or heat-distortable biomaterials. This investigation evaluated the mechanism by which E. coli endotoxin contamination can be eliminated from surfaces during ambient temperature single 3 -minute to cumulative 15-minute exposures to radio-frequency glow discharge (RFGD)-generated residual room air plasmas activated at 0.1-0.2 torr in a 35MHz electrodeless chamber. The main analytical technique for retained pyrogenic bio-activity was the Kinetic Chromogenic Limulus Amebocyte Lysate (LAL) Assay, sufficiently sensitive to document compliance with FDA-required Endotoxin Unit (EU) titers less than 20 EU per medical device by optical detection of enzymatic color development corresponding to < 0.5 EU/ml in sterile water extracts of each device. The main analytical technique for identification of chemical compositions, amounts, and changes during sequential reference Endotoxin additions and subsequent RFGD-treatment removals from infrared (IR)-transparent germanium (Ge) prisms was Multiple Attenuated Internal Reflection (MAIR) spectroscopy sensitive to even monolayer amounts of retained bio-contaminant. Approximate surface areas of 10 cm2 of laboratory glass dishes and germanium internal reflection prisms were inoculated with E. coli bacterial Endotoxin water suspensions at increments of 0.005, 0.05, 0.5, and 5 EU, and characterized by MAIR-IR spectroscopy of the dried residues on the Ge prisms and LAL Assay of sterile water extracts from both glass and Ge specimens. The Ge prism MAIR-IR measurements were repeated after employing 3-minute RFGD treatments sequentially for more than 10 cycles to observe removal of deposited matter that correlated with diminished EU titers. The results showed that 5 cycles, for a total exposure time of 15 minutes to low-temperature gas plasma, was sufficient to reduce Endotoxin titers to below 0.05EU/ml, and correlated with concurrent reduction of major Endotoxin absorption bands at 3391 cm-1, 2887 cm-1, 1342 cm-1, and 1103 cm-1 to less than 0.05 Absorbance Units. Band depletion varied from 15% to 40% per 3-minute cycle of RFGD exposure, based on peak-to-peak analyses. In some cases, 100% of all applied biomass was removed within 5 sequential 3-minute RFGD cycles. An anomalous finding was that the lipid ester absorption band expected at 1725 cm-1 was not detectable until after the first RFGD cycle, suggesting an oxidative chemical event was induced within the gas plasma environment. Future work must determine the applicability of this low-temperature, quick depyrogenation process to medical devices of more complicated geometry than the flat surfaces tested here.

Name: Froebel, Chad

Worked for more than 160 Hours: Yes

Contribution to Project:

additional studies in Photodynamic Therapy

Undergraduate Student

Name: Howell, Chris

Worked for more than 160 Hours: No

Contribution to Project:

University of Memphis undergrad, completing degree in Electrical Engineering and Physics. Accepted into University of Tenneessee Health Science Center Ph.D. program in biomedical engineering.

Name: Walters, Ben

Worked for more than 160 Hours: No

Contribution to Project:

Study of Carbon-centered free radicals

Name: Johnson, Sarah
Worked for more than 160 Hours: Yes
Contribution to Project:
Optical absorption studies.

Name: Sinden Redding, Mackenzie
Worked for more than 160 Hours: Yes
Contribution to Project:
Optical absorption studies.

Name: Williamson, Douglas
Worked for more than 160 Hours: Yes
Contribution to Project:
Analysis of electron spin resonance data.

Name: Mathews, Brinkley
Worked for more than 160 Hours: Yes
Contribution to Project:
Fabrication of anti-oxidant doped ultra-high-molecular-weight polyethylene.

Name: Slaughter, Javon
Worked for more than 160 Hours: No
Contribution to Project:
Independent Study research student examining nature of inorganic fouling deposits on critical components of water purification equipment, supported by residual funding from Industry partner, Trojan Technologies

Technician, Programmer

Name: Forsberg, Robert
Worked for more than 160 Hours: No
Contribution to Project:
Senior Research Support Specialist in the I/UCRC; associated with project until mid-February 2005

Other Participant

Research Experience for Undergraduates

Organizational Partners

University of Memphis
University of Memphis is a subcontractor on this project.

D'Youville College
Students and equipment associated with Dr. Marion Olivieri's laboratory at D'Youville College assisted with the RET portion of this project. In return, University at Buffalo provided access to specialized surface analysis equipment to Dr. Olivieri. Dr. Olivieri is a prior RUI/PUI recipient [EEC-9416826], based on her association with the I/UCRC at University at Buffalo.

Leonardo DaVinci High School
Through Mrs. Celine Wnek (RET stipend), the DaVinci High School provided access to its building for the placement of air-sampling equipment. It also provided the participation of other science teachers (and their students) in the school to participate in the RET project.

Syracuse University

Syracuse University is the lead institution of a 12-institution consortium on 'Environmental Quality Systems'; University at Buffalo (through this I/UCRC) is one of the partner institutions in the EQS consortium. Through the consortium's Capital Funding Project from the New York State Office of Science, Technology, and Academic Research [NYSTAR], we have received $1,273,000 for equipment directly related to this NSF I/UCRC program.

Other Collaborators or Contacts

Numerous contacts with current and potential industry members of the I/UCRC, including NIEQRI, Inc,; Pall Corporation; Praxair, Inc.; Alcon Research, Ltd.; Bausch & Lomb; Owens Corning, Inc.; Austin Air, Inc.; Buffalo Filter; Clean Air Technologies International, Inc.; Failsafe Air Safety Systems; FP Technologies, Inc.;Indoor Air Professionals; MGA Research Corporation; Pharmax, Ltd.; Pure Allergy Friendly Rooms; Second Wind; TSI, Inc.; Veritay Technology, Inc.; Washington Hospital Center; Women's Board of Millard Fillmore Suburban Hospital. Companies and government agencies currently working with the site at The University of Memphis include Los Alamos National Lab; Zimmer; Wright Medical Technology, Inc.; Smith and Nephew; Stryker/Howmedica; Exactech Medical Group; Gyrus ENT; and Medtronic Sofamor Danek.

Activities and Findings

Research and Education Activities: (See PDF version submitted by PI at the end of the report)

The Center submitted a new technical contribution 'In-the-Bus Respirable Particulate Increase from Using B5 Bio-Diesel Fuel' to The 7th International Conference on Indoor Air Quality, Ventilation and Energy Conservation (IAQVEC 2010), with 3 SUNY Buffalo undergraduate students as primary authors. One of these authors, Mr. Alex Borsuk, has in recognition of this work and related achievements been nominated for the Barry M. Goldwater Scholarship to support his continued pursuit of an environmentally focused research career. The tailpipe emissions monitoring equipment utilized for these studies has been further upgraded by local Industry partner Clean Air Technologies, International, to improve gas emissions selectivity, diminish system size, and perform automated calibration. Continued maintenance and operation of the in-the-bus air quality monitor, the Aircuity Optima 500, has been shifted to in-Center responsibility since funding for the required annual support contract has not been available.

Industry partner PURE Solutions LLC was, on 3 August 2010, issued US Patent No. 7767141 for the Pure Allergy Friendly Room process independently evaluated by the Center and first publicly described at the 2007 Annual Symposium of the Syracuse Center of Excellence in Environmental and Energy Systems. On 13 October 2010, Hyatt Hotels & Resorts announced plans to utilize these Center-evaluated processes to bring more hypo-allergenic rooms to its guests than any other hotel brand, scheduling PURE conversion of approximately 2000 hospitality rooms in 125 properties. Two new Center-supported Masters Degree students, one in Mechanical Engineering and the other in Biological Sciences, are now examining the endotoxin-related issues associated with the fine suspended dust particles trapped in such hospitality room air filters.

The Center-provided 'bridge' video-conferencing MCU usage has decreased in the past year as the cost to buy the equipment has dropped significantly and more institutions acquire their own units. Consumer-grade video communications are also being more utilized for meetings previously hosted by the Center MCU, now mainly supporting continuing education for the School of Dental Medicine and multi-point needs of the School of Nursing.

Work effort in the holographic imaging of suspended fine particles has been reduced in the past year while the project Principal Investigator remains on sabbatical in Japan.

Findings:

Information on each project in which a significant research accomplishment has been achieved at the Center since the last report was submitted:

Project Name: Control of Nosocomial Infections in Public Health Facilities
Principal Investigator: Robert E. Baier, Ph.D., P.E.; Anne E. Meyer, Ph.D.,
Maureen P. Donley, D.D.S (Director of Radiology)
Research Sponsor: UB School of Dental Medicine, National Science Foundation; Industry/Univ. Ctr. for Biosurfaces
Research Funding Amount: services-in kind; University faculty, residents, graduate students

In connection with a University at Buffalo Strategic Initiative in Extreme Events, an Incident Dynamics sub-group is developing test scenarios for dealing with aggressive infectious microorganisms that might emerge within a large public health facility. The relevant prior model is that of the SARS epidemic of recent years in a Toronto, Canada hospital. Now, seeking information on the possible risk of advection of infectious organisms to the adjacent community of bioaerosolized microbes from Dental Clinic operations, atmospheric plume studies around an architectural scale model of the UB School of Dental Medicine are being planned with Center colleagues at Clarkson University.

Project Name: Videoconferencing Operations
Principal Investigators: Lisa Stephens, Ph.D., David Shurtleff, Mark Woodward
Sponsor: This NYSTAR CFP (equipment)
and University at Buffalo (personnel)
Funding: NYSTAR-EQS; University at Buffalo

Reporting statistics through December 31, 2010 show system support for NYSTAR videoconferencing operations to be diminished from the prior level, but still exceeding 100 operations for the preceding term. Especially important has been continuing use of the system for communications by the Schools of Dental Medicine and Nursing.

Project Name: Erie County Clean School Bus Initiative (ECCSBI)
Principal Investigators: Robin Paget, Thomas Hersey, Bonnie Lange Lawrence,
Erie County Department of Environment and Planning
Robert Baier, University at Buffalo
Michael Dio, Brian Beckmann, Clean Air Technologies
Adam Blair, Dylan Hofsiss, Alex Borsuk, Corey Hmiel, Engineers for a Sustainable World
Sponsor: Erie County Department of Environment and Planning
Industry/University Center for Biosurfaces, Clean Air
Technologies, International, Inc. (CATI)
Funding: CATI services-in kind; University undergraduate and graduate students participate in curricular Independent Study assignments

Work on this project has been suspended as the effort has continued to shift mainly to physical retrofitting of regional School District bus fleets. Another period of active bus monitoring is expected for late 2011.

Project Name: Collaborative Biodiesel Testing Project
Principal Investigators: Michael Dio, Adam Blair, Alex Borsuk, Dylan Hofsiss
Sponsor: UB Facilities Operations, National Science Foundation;
Industry/University Center for Biosurfaces, Clean Air
Technologies, International, Inc. (CATI)
Funding: CATI services-in kind; University undergraduate
students participate in curricular Independent Study assignments

Testing of fuel-substitution impacts was completed for a representative inter-Campus shuttle bus of the fleet at University at Buffalo. Students from Engineers for a Sustainable World (ESW), along with support from Industry/University Center for Biosurfaces (IUCB), Clean Air Technologies International, Inc. (CATI) and New York State Foundation for Science, Technology and Innovation (NYSTAR) performed tailpipe emissions and in-the-bus air quality testing on a diesel bus operating on an infrared spectroscopy-certified B5 blend of Biodiesel, after that same bus was monitored first with ester-free conventional diesel fuel traveling over the identical city streets plus highway route. Data were collected using the IUCB-provided Aircuity Optima 500 System and Montana Portable Emissions Monitoring System (PEMS, Clean Air Technologies International, Inc.). Respirable particulate emissions and in-the-bus gaseous pollutants surprisingly increased when the B-5 fuel was used, while nitrogen oxides, hydrocarbons and carbon dioxide showed decreases.

Project Name: Emissions: Design Improvements of Monitoring Equipment
Principal Investigator: Robert Baier, UB and Michael Dio, Earl Leatherland, Clean Air Technologies, Inc.

Sponsor: Industry/University Center for Biosurfaces
Funding: Clean Air Tech. (proprietary); IUCB portion in-kind

This study was designed for continuous improvement of the portable emissions measurement Axion System. Market and educational institution drivers indicated that several factors could be recalculated to improve appeal, accuracy, simplicity, and flexibility. These factors included increased gas emissions selectivity, system size, and calibration accuracy.

Advances have been made in each of the above factors:
? Gas Emissions Selectivity ? With the development of Selective Catalytic Reduction (SCR) systems, ammonia dispersal into the emissions stream has the potential to increase. Market demand has driven for the development of flexible NH3 measurement instruments. As this type of instrumentation is extremely new, this places CATI and the University at Buffalo on the cutting edge of emissions testing technology.
? System Size ? Experimentation was performed to determine the size constraints a viable PEMS unit could be encompassed within. With a number of months of design and redesign, in conjunction with baseline comparison with the existing University of Buffalo PEMS, a new product was verified and is now available to market. This new product is flexible to meet demand of smaller vehicles, such as motorcycles, mopeds, motor scooters, and lawnmowers. The previous products were already available at this level, but now their flexibility in size makes the application much easier.
o Testing has successfully verified accuracy of the more compact Axion hardware in laboratory situations.
? Automated calibration ? Software automation changes continue to be implemented to reduce manual involvement in the calibration procedure.
? Hardware Adjustment for Calibration ? Calibration has been improved with the introduction of restrictors into the calibration lines. Due to the sensitivity of the Axion System, calibration air pressures must be kept within strict tolerances. This has led to the addition of restrictors into the calibration lines to further eliminate the possibility of human error during calibration.
The improved system has been a result of ongoing testing, evaluation, and customer feedback. This is an ongoing project.
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Project Name: Impact of Air Quality Interventions in Conference Rooms
Principal Investigator: Anne E. Meyer, Ph.D., Robert E. Baier, Ph.D., P.E.
Research Sponsor: Pure Allergy Friendly Rooms (T. Pickles), Inc.,Pure Solutions LLC, (Goran Andersson)
National Science Foundation; Industry/Univ. Ctr. or Biosurfaces
Research Funding Amount: Mutual services-in-kind

? US Master Licensee has received a letter of intent from a national hotel chain to convert 2,800 rooms over the next 9 months. The contract, valued at over $10.0 million, with initial work started in July 2010, will generate substantial royalty fees for the Company.
? PURE is in final negotiations with the owner of 153 Five Star hotels in India, for an initial trial conversion of 76 rooms at a price of $240K and a net profit of $150K.
? PURE's Master Licensee in Taiwan has been successful in having 'PURE Allergy Friendly Rooms' become a brand standard for the Starwood Luxury Hotels.
? PURE just completed its first pilot project in Greece, with a well known 5-Star property.
? Negotiations have been ongoing for a new Master Licensee in Turkey.
? Several hotel executives from IHG, the largest hotel owner in the world, have expressed interested in a Master License for the UK.
? PURE Marine has several projects near approval including a large condo cruise ship.
? Grand Hyatt San Francisco has successfully tested a smoking room conversion program, charging a $50/night premium on a 40/60 revenue share program with US Master Licensee.
? PURE Marine and Carnival Cruise Lines had a major meeting to discuss joint branding strategies.

? The Oberi hotel group in India, owner of one of the recently bombed hotels, is in discussions to make 'PURE Allergy Friendly Room' a brand standard.

? PURE's Taiwan Master Distributor has been awarded contracts to add allergy treated branches for several banks in Taiwan and Singapore.

Project Name: Surface Characterization of Tissues
Principal Investigator: Anne Meyer, Robert Baier
Funding Source: Ethicon, Inc. Division of Johnson & Johnson
Funding Amount: $45279
Funding Time Period: 10/01/2006 ? 09/31/2009 {extension to 09/31/2011 in progress)

This project has recently been re-activated to focus on the concept of 'tissue integration' for implantable biomaterials. Emphasis is currently placed on examination of criteria of surface composition and Critical Surface Tension, as they affect cellular wetting, spreading and adhesion.

Project Name: Fundamental Biodynamic Relationships at Tissue
Surfaces Exposed to Hydrodynamic Shear Stresses
Principal Investigator: Robert Baier, Anne Meyer, Lindsay Rodgers, Jonathan Prindle
Funding Source: Alcon Laboratories, Ft. Worth, TX
Funding Amount: $269,873
Funding Time Period: 4/17/2007 ? 12/31/13

Independent measurements using surfactant-sensitive laboratory techniques removed ambiguity from prior 'captive-bubble' dynamic testing results for disinfecting solutions containing combined surfactants. In vitro, sessile-droplet contact angle data supported by Multiple Attenuated Internal Reflection InfraRed (MAIR-IR) Spectroscopy confirmed preferentially retained and longer term improved water wettability for Silicone Hydrogel (SiH) contact lenses treated with EOBO copolymer-containing formulations. The apparent mechanism of sustained wettability improvement is by novel embedment of the BO copolymer segments into methylsilicone domains of the SiH lenses, varying with specific lens compositions, exposing the water-loving EO copolymer segments outermost. This is a novel mechanism of action, supplementing simple absorption and reservoir/depot effects that can also take place with EOBO and other surfactants lacking EOBO's specific molecular geometry. Exposure to air triggers spontaneous de-wetting of EOBO-modified SiH lens as water and the stretched EO side chains retract to the smaller area coverage required by surface energy minimization forces at the silicone/air interface.

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Training and Development:
BMA 520 (4.0 credits) and MAE 514 (3.0 credits) - Evaluation of Biomedical Materials
Spring 2011
Course Directors:
Robert E. Baier, Ph.D., P.E. baier@buffalo.edu
(Professor & Director, Biomaterials Graduate Program)
Anne E. Meyer, Ph.D. aemeyer@buffalo.edu
(Research Assoc. Professor & Site Director, Industry/Univ Ctr for Biosurfaces)
for both Course Directors: telephone: 829-3560 fax: 835-4872
office: 110 Parker Hall (South Campus)

Schedule: Mondays and Fridays, 4:00 ? 5:45pm
Location: 104 Parker Hall (South Campus)

Prerequisite: Graduate or Upper Level Undergraduate Standing

General Objectives: This course serves a multidisciplinary group of students, assuming a starting level of Bachelor's degree knowledge. From that point, we will address (1) characteristics of specific materials used for various types of devices; (2) selection criteria based on function and longevity; (3) performance testing in vitro and in vivo; (4) evaluation of material breakdown in biological media, and potential toxicologic consequences; (5) design of clinical trials; (6) surgical considerations; and (7) ethical, regulatory, and legal issues. The course utilizes your primary field of expertise as a guide to specific topics of biomaterials evaluation. A 'case study' midway through the course allows you to work together to actually design and promote a new implant device for an unmet medical need, with particular attention to regulatory requirements and market realities. You are encouraged to share your own expertise with the faculty and your colleagues in the class. The anticipated schedule of topics is given on the reverse side of this page.

Requirements and Evaluation Criteria
 Adherence to the University's Academic Integrity requirements

 Case Study (Group Project) Preparation and Presentation (30% of final grade)

- extent of contribution to group productivity
- apparent extent of preparation for assigned role
- ability to anticipate and respond to materials-related problems
- correctness of information presented

 Written Paper (15% of final grade)
- clarity of written presentation (background discussion, concepts, pros/cons of technique or device, recommendations)
- correctness of information presented; annotated reference list
- synthesis of recommendations/conclusions based on scientific, economic, ethical, regulatory, and sociological factors
- spelling, punctuation

 Take-Home Test (15% of final grade)
- clarity and correctness of answers to short answer/essay questions, emphasize fundamental concepts

 Final Examination (Oral) (40% of final grade)
- demonstration of understanding of concepts of biomaterials evaluation (pre- and post-implant)
- demonstration of ability to suggest/outline a reasonable series of investigations for any material/end-use scenario and to discuss rationale for selection
- demonstration of understanding of key issues in the development of biomedical devices (e.g. in vitro model design; in vivo models; clinical trials; regulation of laboratory studies, animal studies, and clinical trials; FDA device review and approval processes)
- percentage and number of questions answered correctly within 1-hour period

 Class Attendance, Constructive Participation in Class, Completion of Recommended Reading
(These items are positive factors for numerical scores that are close to next-higher letter grade.)

 Course Evaluation ? You may be asked to evaluate the course content, lectures, and faculty in a written format at two points in the course.

BMA 520 and MAE514 - Evaluation of Biomedical Materials Spring 2011
Planned Schedule of Topics (Mondays and Fridays, 4:00 ? 5:45pm)
17jan2011 No class ? Martin Luther King, Jr. Day (university closed)
Date Topics to be Addressed

21jan2011 - introductions, themes, resources, review of text*
- special product issues: artificial hips, blood vessel grafts, heart valves
24jan2011 - types of materials: polymers, metals, ceramics, biologicals
- choices of materials: mechanical requirements v. surface biocompatibility
28 Jan 2010 - review paper assigned
28jan2011 - blood contact, coagulation, and thrombosis
31jan2011 - biocompatibility issues: inflammation, thromboresistance, tissue integration
04feb2011 - reference materials: polymers, metals, ceramics, carbon, preserved tissue
07feb2011 - surface analysis: critical surface tension, film thickness and identification
- discuss and hand in title/abstract for assigned paper
- case study/project: problem assigned, roles assigned
11feb2011 - in-vitro testing
14feb2011 - case study/class project: development of product design strategy
18feb2011 - case study/class project: development of regulatory and marketing strategy
21feb2011 - in-use testing and post-implant evaluation
- turn in review paper; receive take-home test
25feb2011 - host reactions
- corrosion, biodegradation, wear, particles
28feb2011 - animal research issues; biodeterioration of materials
04mar2011 - regulatory environment of medical devices
07mar2011 - general surgical considerations; clinical trials; human subjects' regulations
- turn in take-home test
11mar2011 - biomaterials-centered infection
March 14-19 UB's Spring Recess ? no classes

21mar2011 - dental and TMJ implants
25mar2011 - class project/design study ? first report
28mar2011 - class project/marketing study ? second report
01apr2011 - contact lenses and intraocular lenses
04apr2011 - bioceramics
08apr2011 - orthopaedic appliances
11apr2011 - artificial hearts and LVADs
15apr2011 - case study presentation: design/cost/regulatory issues
18apr2011 - drug delivery systems; sutures
22apr2011 - blood vessel grafts
25apr2011 - sterilization and disinfection: effects on materials
29apr2011 - 'universal principles' for biomaterials design
02may2011 - overview of course and summary of themes; Q/A
? last day of classes; selection of final exam appointments
UB Final Exam Period: May 5-May 12, 2011

* Texts were available for loan by Dr. Baier for the semester.

The text was Handbook of Biomaterials Evaluation: Scientific, Technical, and Clinical Testing of Implant Materials, AF von Recum (editor), MacMillan Publishing Co., 1986.

Outreach Activities:

Wettability of Contact Lenses
A Recommended 'Teflon Test' Control Technique

Wettability by what? Why do we care? In the blinking or open eye, the competition between tear film components and the adjacent air for coverage of the lens surface is directly related to patient comfort and ocular health. ALL liquids DO wet ALL solids to some extent, and we use the contact angle formalism of the venerable Thomas Young (1805) to make quantitative statements about the degree of surface wetting in terms of the equilibrium contact angles of test liquids with the surfaces in question. In such test systems, with many 'unknowns', it is critical that the air/liquid surface tension values of the wetting liquids be accurately determined AND maintained throughout?and beyond-- the lens/liquid interface interaction. For contact lenses, it has been universally accepted that their surface wetting by water will be the standard by which the comparisons should be made. Our institutional problem, leading to often-cited variability of reported contact angle values, is that most investigations use 'dirty water' ?that is, water NOT of the required initial highest purity with a measured high liquid/vapor surface tension of 72.8 dynes/cm at 20 degrees {at the moment of first contact with the lens surface and generally much lower after that}. It is especially difficult to maintain water's required high surface tension in large-volume test systems where multiple contact surfaces are simultaneously present from containers, needles, syringes, and is a serious further error to actually add surfactants to the system to obtain investigator-sought 'more reasonable' data.
Liquids of starting surface tensions lower than that of pure water WILL exhibit lower equilibrium contact angles than will pure water on all surfaces, giving misleading indications of apparent hydrophilicities for those test materials. Pure water put onto a lens surface that 'exports' surface-active ingredients to the water, even in minute amounts, substantially lowers the surface tension of that water and again gives a falsely lower apparent water contact angle value for that surface. Lens surfaces that imbibe water, no matter how pure it may be, do not allow the EQUILIBRIUM requirement of the Young equation to be met and so do not characterize the water wettability of those lens surfaces but rather their bulk uptake properties. For better comparisons, the advanced formalism of Zisman (1968) to determine Critical Surface Tension values from contact angle measurements with multiple pure liquids gives reliable, reproducible correlations with materials' actual outermost atomic constitutions?even for hydogels where the water contact angle is not a stable value.
Here is a way to establish trustworthy analytical results. Take a single droplet of the proposed 'water' test liquid, and apply it to a clean, smooth Teflon (PTFE) surface. According to Zisman and numerous following experts, that water-on-PTFE contact angle value should be greater than 110 degrees (and higher if there is surface roughness). If it is lower, you are NOT doing a water wettability test. If the initial water contact angle is 110 degrees or higher, proceed with the measurement on the lens surface AND then take water AFTER the test for re-application to the Teflon surface. If the contact angle is not STILL above 110 degrees, there has been surface-active contamination of the water and your measured values do NOT characterize lens materials' water wettabilities. Simply touching a contact lens to a free-standing 110 degree water droplet on Teflon will cause that water's contact angle to immediately slump to lower values in proportion to the surface-active components spontaneously eluted. When extensive prior elution has been done, and the pure water contact angle on an eluted lens surface is still low, THAT is a reliable signature of a material surface with sustained hydrophilicity. Simply adsorbing elutable water-loving substances onto lens surfaces,

or compounding them with elutable bulk additives, can give potential short-term clinical benefits but this is not related to intrinsic material wettability.

References: T. Young, Phil. Trans. Roy. Soc. London 95, 65 (1805)
R.E. Baier, E.G. Shafrin, W.A. Zisman, Science 162, 1360 (1968)

Dry Mouth Relief

Many elderly people, those taking multiple medications, and those having been exposed to radiation and/or chemotherapy for cancer treatment suffer from the problem called 'dry mouth', more formally known as 'xerostomia'?interfering with nutritional states as well as causing serious discomfort and predisposing to dental diseases. Most commercial preparations, sold as 'saliva substitutes', do not lubricate the oral cavity very well and do not have a time of action exceeding one hour due to the 'dry mouth' environment causing their quick loss of water. This ongoing work is research, testing, and education for a novel formulation of safe and effective ingredients that can provide superior lubrication of tissue.

Cystic Fibrosis Relief

The Center is also developing a project for Combating Respiratory Infections in Cystic Fibrosis Patients by use of an FDA- Approved Anti-Biofilm Surfactant. After 20+ years of basic investigations, it is time to move from bench to bedside! Prior research with international collaborators has identified a safe, effective surfactant ?approved by EU and US FDA regulators for intraoral use? capable of rapidly dispersing dental plaque biofilms in vivo and earlier demonstrated by us, in vitro, to equally well disperse the congestive exopolymers of Cystic Fibrosis-associated strains of Pseudomona aeruginosa. Support is being gathered for a Pilot Collaborative clinical translational project to generate preliminary data for submission of research grant applications, improving clinical design and advancing from pre-clinical to clinical research as a prominent component of the Buffalo Clinical and Translational Research Center. Cystic Fibrosis is a genetic disease which results in diminished mucociliary and airway clearance of respiratory secretions. This creates an environment for chronic airway infection. Our prior joint studies have shown that a novel human-use-approved surfactant, delmopinol, can diminish Pseudomonas growth during in vitro studies. European colleagues have reported that use of this compound in mouthwash, alone, significantly decreased antibiotic and nasal decongestant needs in normal human subjects during Phase III Clinical Trials. This planned Pilot Study will be the first to examine demopinol use in CF patients. Women's and Children's Hospital's Adult Cystic Fibrosis Program will recruit 16 adult CF patients with positive Pseudomonas cultures and PFT's greater than 35% into an experimental crossover designed treatment vs pacebo trial, with results generalizable to the adult CF population colonized with Pseudomonas.

Journal Publications

Diggins TP, Weimer M, Stewart KM, Baier RE, Meyer AE, Forsberg RL, and Goehle MA, "Epiphytic Refugium: Are Two Species of Invading Freshwater Bivalves Partitioning Spatial Resources?", Biological Invasions, p. 83, vol. 6, (2004). Published,

Drake LA, Meyer AE, Forsberg RL, Baier RE, Doblin MA, Heinemann S, Johnson WP, Koch M, Rublee PA, and Dobbs FC, "Potential Invasion of Microorganisms and Pathogens via "Interior Hull Fouling": Biofilms Inside Ballast Water Tanks", Biological Invasions, p. , vol. , ( ). Accepted,

Tang Y, Finlay JA, Kowalke GL, Meyer AE, Bright FV, Callow ME, Callow JA, Wendt DE, and Detty MR, "Hybrid xerogel films as novel coatings for antifouling and fouling release", Biofouling, p. 59, vol. 21, (2005). Published,

Jahan MS and Durant J, "Investigation of the Oxygen-Induced Radicals in Ultra-High Molecular Weight Polyethylene", Nucl Instr Meth in Phys Res B (NIMB), p. 166, vol. 236, (2005). Published,

Durant J and Jahan MS, "EPR Power Saturation Techniques and Spectral Differentiation are Used to Isolate and Simulate Radical Species in UHMWPE", Nucl Instr Meth in Phys Res B (NIMB), p. 160, vol. 236, (2005). Published,

Books or Other One-time Publications

Nagathan P, ""Optical Tweezer" Studies of Shear Resistance of Microscopic Particles Attached to Characterized Surfaces: Implications for Self-Cleaning Biomaterials", (2004). Thesis, Published
Bibliography: M.S. thesis, State University of New York at Buffalo

Baier RE, "Bacteria-sensitized Systems: Semiconductor Microcrystals Nucleated by Microbes in UltraPure Water", (2005). Proceedings, Published
Bibliography: Prcdgs, 2005 Annual Mtg of the North American Membrane Society, abstract #993, page 210

Baier RE, "Solar-Activated Photocatalytic Purification of the Clinical Air Circulating in a Dental Hospital", (2005). Proceedings, Published
Bibliography: Prcdgs, 8th International Conference on Solar Energy and Applied Photochemistry

Baier RE, Latini LJ, and Meyer AE, "An Industry-University Cooperative Study: Advanced Oxidation Techniques for Ultrapure Water Systems Modify Polymers Used in Degasification Modules, by Hydrolysis and Biodeposition", (2005). Proceedings, Published
Bibliography: Prcdgs, 2005 Annual Mtg of the North American Membrane Society, abstract #767, page 85

Baier RE, Mahajan SP, Meyer AE, and Jahan MS, "Wear Facets and Particulate Production Associated with Co-Cr-Mo Alloy-Articulated UHMWPE Radiation-Sterilized and Stored in Different Gaseous Environments", (2005). Proceedings, Published
Bibliography: Prcdgs, 24th Canadian Biomaterials Society Conference, pp 97-98

Forsberg R, Baier R, Meyer A, Doblin M, and Strom M, "Fine Particle Persistence in Ballast Water Sediments and Ballast Tank Biofilms", (2005). Proceedings, Published
Bibliography: Prcdgs, 28th Mtg of The Adhesion Society, pp 92-94

Nagathan P, Baier R, Forsberg R, and Meyer A, "Inorganic Particulate Detachment into Medical Air Outlets of Hospitals and Dental Clinics", (2005). Proceedings, Published
Bibliography: Prcdgs, 28th Mtg of The Adhesion Society, pp 464-466

Barrett J, Baier R, Forsberg R, and Nagathan P, "On-Line Recording and in situ Verification Sampling of an "Allergy Friendly Room" Treatment Protocol", (2004). Abstracts Book, Published
Bibliography: Abstracts, 2004 Syracuse Symposium on Environmental and Energy Systems

Forsberg R, Baier R, Ortman L, Patashnick H, and Rogers W, "Event-Segmented Collection and Identification of Bioaerosols in a Busy Dental Clinic", (2004). Abstracts Book, Published
Bibliography: Abstracts, 2004 Syracuse Symposium on Environmental and Energy Systems

Ridley M, Howell C, and Jahan MS, "Effects of Heating on the Oxygen-induced Radicals in Post-gamma Aged Ultra-high Molecular Weight Polyethylene", (2005). Transactions, Published
Bibliography: Transactions of the Society For Biomaterials

Gray JM and Jahan MS, "Thermal Characterization of Post-Gamma Shelf-Aged Polyethylene", (2005). Transactions, Published
Bibliography: Transactions of the Society For Biomaterials

Durant J and Jahan MS, "Out-gassing Reduces the Oxidative Potential of Radiation Processed UHMWPE", (2005). Transactions, Published
Bibliography: Transactions of the Society For Biomaterials

Jahan MS and Durant J, "Investigation of the Oxygen-Induced Radicals in Ultra-High Molecular Weight Polyethylene", (2004). Abstract, Published
Bibliography: 6th International Symposium on Ionizing Radiation and Polymers, Belgium, Sep 2004

Web/Internet Site

URL(s):

http://wings.buffalo.edu/faculty/research/iucb

Description:

This is the "home" website of the Industry/University Cooperative Research Center for Biosurfaces [IUCB]. There is a link on this site to our IUCRC partner at The University of Memphis.

Other Specific Products

Product Type:

Workshop

Product Description:

Workshop at The University of Memphis on May 4, 2007:
"Influence of Patient Factors on Implant Performance"

Please see uploaded document in "Activities" portion of report.

Sharing Information:

All presentations & discussion during the workshop were sound-recorded. These recordings now are being put together with the presenters' PowerPoint files as the first draft of a publication. We currently are evaluating potential outlets (e.g. special journal publication; self-publication by University of Memphis) and formats (e.g. hardcopy; DVD or CD) for the publication.

Contributions

Contributions within Discipline:

Course Outline

BMA 501 - Biomaterials Science of Cell-Surface Phenomena

Objective: 'Epigenetics' refers to living cell behavioral phenomena determined by factors beyond the genetic code. Living cells' contacts with synthetic materials are clearly different as the materials' surface properties change. The goal of this Course is to refine and build upon your prior knowledge of the basic properties of fabricated plastics (polymers), metals, ceramics, and natural substances, by adding a detailed understanding of contact interactions between living and nonliving substances, and their consequences for public and environmental health.

BMA 501 - Biomaterials Science of Cell-Surface Phenomena (3.0 credits)
crosslisted as BPH 501 (3.0 credit hours), as BPR 501 (3.0 credit hours)
as ODS 501 (3.0 credit hours), and as MAE 607 (3.0 credit hours)

Topics Covered

DATE TOPIC
01sep2010
proteins as interfaces and proteins at interfaces (perspectives)
08sep2010
solid/liquid, gas/liquid, solid/gas interfaces
15sep2010
'conditioning films', 'primary films', and 'biofilms'
22sep2010
biocompatibility/hydrophobicity/malpractice
29sep2010
wetting, spreading, and adhesion
06oct2010
cell-cell interactions; adhesion v. aggregation
13oct2010
**in-class examination
20oct2010 **receive research paper assignment
biomaterials-centered infections
27oct2010
surface cleaning and modification
03nov2010

osseointegration: dental and orthopedic implants
10nov2010
cell membrane models and analogs
17nov2010
cancer, contact inhibition, contact promotion
24nov2010
NO Class?Fall Recess
01dec2010
**turn in research paper; phagocytosis and Oppenheimer effect
08dec2010
final exam review; make individual appointments for final exam

Semester final examinations: December 13-20, 2010
** Final exam during this period.

** course requirement, in addition to class attendance and participation

Contributions to Other Disciplines:

BMA 513 - Polymeric Biomaterials Fall 2010
cross-listed as MAE 608
Course Outline

Course Schedule: Mondays, 4:00-5:30pm and Fridays, 4:00-5:30pm
Location: 104 Parker Hall [South Campus]

Objective: To familiarize you with the vocabulary, definitions, compositions, and unique features of natural and synthetic polymeric materials, so that (1) practical decisions can be made regarding 'biocompatibility' of these materials in different circumstances and (2) research articles in the current biomaterials peer-reviewed literature can be reviewed, comprehended, and authoritatively critiqued by course participants.
BMA 513/MAE 608 - Polymeric Biomaterials Fall 2010
Plan for Topics to be Covered

MONDAYS - Date and Topic
FRIDAYS - Date and Topic

30aug2010 - introduction and the basics; natural biopolymeric surfaces: skin, cornea, cartilage, dolphins, heart worms 03sep2010 ? from methane to polyethylene; plasticizers, antioxidants, catalysts from polyethylene to polyacrylics; polyvinyls, polycarboxylates
06sep2010 ? Labor Day holiday
- University is closed. No Class sessions. 10sep2010 ? Health Sciences Library Assignment on 'Medical/Dental Polymers'
13sep2010 - collagen in skin, teeth, bone, and
blood vessels; important structures of proteins 17sep2010 - tradenames: Dacron, Mylar, Teflon,
Lexan, Lycra, Delrin, Plexiglass, Hydron
20sep2010 - alpha helix, beta structure & triple helix conformations; fibrinogen, fibrin, albumin,
gamma globulin 24sep2010 ?polyesters, polyethers,
polyurethanes, polyacrylates
27sep2010 ? Health Sciences Library Assignment DUE, and Take-Home Exam issued* --Discussion of Findings 01oct2010 ?'RGP' polymers; silicone acrylates,
contact lenses & IOL's; polyHEMA, hydrogels;
hydrophobicity v. surface energy
04oct2010-- sterilization and surface
modification of polymers
*Take-Home Exam Due 08oct2010 -? glycoproteins, proteoglycans;
mucopolysaccharides;

** receive case study & written paper assignment
11oct2010 - surface properties of biological
polymers 15oct2010 ? silicones: 'medical' v. commercial'

18oct2010? In-Class Exam 22oct2010 ?polyfluorocarbons: Teflon, GoreTex;
particles v. 'guided tissue' membranes
25oct2010 ? polysaccharides, DNA, RNA,
genomics, proteomics
** turn in Abstract for written paper 29oct2010 ? polyhydroxyalkanoates;
polyglycolides; polylactides;
resorbable sutures
01nov2010 ? bioprosthetic blood vessels;
mandril grafts; tissue engineering
05nov2010 ? dental adhesives;
hybrid-layer bonding;
advanced composites
08nov2010 ? bioprosthetic heart valves;
biological v. synthetic components 12nov2010 ? prosthetic wear and friction:
UHMWPE and sterilization effects

15nov2010 ? glutaraldehyde tanning and
crosslinking of protein-based tissues 19nov2010 ? artificial hearts and LVADs
(left ventricular assist devices)
and valves
22nov2010 ? biopolymeric adhesives,
mussel glue, barnacle cement;
'RGD' groups 26nov2010 ? no class today (Fall Recess)
29nov2010 - **assigned papers due; Q/A
03dec 2010 - polymeric materials for tissue engineering
06dec2010- natural polymers for tissue lubrication and adhesion prevention 10dec2010- exam preparation
**Final Exam will be scheduled for exam week (December 13-20, 2010)

** course requirement, in addition to class attendance and participation

Contributions to Human Resource Development:

BMA 501 - Biomaterials Science of Cell-Surface Phenomena (3.0 credits)
crosslisted as BPH 501 (3.0 credit hours), as BPR 501 (3.0 credit hours)
as ODS 501 (3.0 credit hours), and as MAE 607 (3.0 credit hours)
BMA 501 - Biomaterials Science of Cell-Surface Phenomena (3.0 credits)
crosslisted as BPH 501 (3.0 credit hours), as BPR 501 (3.0 credit hours)
as ODS 501 (3.0 credit hours), and as MAE 607 (3.0 credit hours)
Course Outline

Course Schedule: Wednesdays ? 2:30 to 5:00pm
Location: 146 Diefendorf Hall [South Campus]

Objective: 'Epigenetics' refers to living cell behavioral phenomena determined by factors beyond the genetic code. Living cells' contacts with synthetic materials are clearly different as the materials' surface properties change. The goal of this Course is to refine and build upon your prior knowledge of the basic properties of fabricated plastics (polymers), metals, ceramics, and natural substances, by adding a detailed understanding of contact interactions between living and nonliving substances, and their consequences for public and environmental health.

Topics to be Covered

DATE TOPIC
01sep2010

proteins as interfaces and proteins at interfaces (perspectives)
08sep2010
solid/liquid, gas/liquid, solid/gas interfaces
15sep2010
'conditioning films', 'primary films', and 'biofilms'
22sep2010
biocompatibility/hydrophobicity/malpractice
29sep2010
wetting, spreading, and adhesion
06oct2010
cell-cell interactions; adhesion v. aggregation
13oct2010
**in-class examination
20oct2010 **receive research paper assignment
biomaterials-centered infections
27oct2010
surface cleaning and modification
03nov2010
osseointegration: dental and orthopedic implants
10nov2010
cell membrane models and analogs
17nov2010
cancer, contact inhibition, contact promotion
24nov2010
NO Class?Fall Recess
01dec2010
**turn in research paper; phagocytosis and Oppenheimer effect
08dec2010
final exam review; make individual appointments for final exam

Semester final examinations: December 13-20, 2010
** Final exam during this period.

** course requirement, in addition to class attendance and participation

Contributions to Resources for Research and Education:

please see uploaded file in 'Activities' portion of report

Contributions Beyond Science and Engineering:

Science for Non-Science Majors--- a Course to fulfill General Education Requirements for College Graduation:

UGC 302BAI:Science - Microworld: Medical Implant Controversies Spring 2011

COURSE DIRECTORS: Robert E. Baier, Ph.D., P.E. baier@buffalo.edu
Anne E. Meyer, Ph.D. aemeyer@buffalo.edu
Phone: 829-3560
110 Parker Hall (South Campus)
Industry/Univ. Center for Biosurfaces
Day/Time: Tuesdays & Thursdays - 9:30am - 10:50am
Location: 103 Diefendorf Hall (South Campus)

Class Schedule/Plan for Topics and Assignments - see attached

Purpose: This course is designed for undergraduate students who are interested in learning about medical implants (e.g. breast and buttock implants, eye lens implants, artificial hips). Our purpose is to present key scientific and engineering concepts about life-saving and life-enhancing devices used in and on humans. The impacts of federal regulations and medical ethics on implant use are two main themes. The course (a) provides information to help you with ethical concerns about implant development and use and (b) provides opportunities for you to develop critical thinking skills for evaluation of your own and your family's options for implants and testing devices that may be recommended to you.

Goals and Outcomes:
1. Identify the types of materials used in major surgical repairs and 'make-overs' to the human body, and explain how they were selected.
2. Learn the range of manufactured devices used in different medical and dental operations.
3. Discover the interplay of biological science, engineering, legal, manufacturing, management, financial, marketing, and regulatory skills, and serendipity, leading to new implant concepts.
4. Appreciate the roles and positions of many 'stakeholders' in the inspiration, research, production, benefits, and failures and successes of prosthetic implants and implant-based operations.
5. Survey basic science and engineering concepts which are keys to the development and use of safe and effective medical and dental devices, allowing understanding of 'side effects' issues.
6. Acquire new knowledge about inflammation, immune reactions, infections, cloning, cancer, and the body's normal responses to implanted materials.
7. Become 'educated consumers' when considering medical and dental devices and implants.

Text and Course Resources: Course Documents provided through UB Learns will serve in lieu of a formal text. You are expected to attend and participate in each class session. Reading assignments will be provided as material accessible via the UB Learns website. For most class sessions, a glossary of key terms to be used that day will be provided on the UB Learns website for this course. Video footage of relevant implant situations will dramatize many of the issues, and class-wide discussion will be encouraged.

Evaluation: You will be responsible for learning the information and concepts presented in class, in addition to what is provided on the UB Learns website for the course. Your grade will be based on the following four main items, including attendance/participation:
1. Exams - 35% of course grade
- Take-home Exam [15%]
- Final Exam [20%]
2. Anatomy & Physiology Information Search - 30% of course grade
- Drawing/schematic of assigned part or system [5%]
- 3- to 5-minute Oral Presentation on how the part or system works [10%]
- Annotated resources on implant assistance/replacement of the part or system [15%]
3. Quizzes - 25% of course grade
- Five pre-announced, in-class, 15-minute quizzes [5% each]
4. Attendance/participation - 10% of course grade

Grading: Each assignment (e.g. a quiz, the annotated resources, an exam) will be graded as a flat A, B, C, D, or F if completed on time. Spelling, punctuation, and grammar 'count' on the written summary, written papers in your own words, and take-home exam. Late assignments will be handled as described below.

Academic Integrity: You are expected to do your own work and show your own skills in this course. Information obtained from internet sources or sections of assignments copied from other sources without proper reference will be graded 'F'. By registering for this course, you also have agreed to adhere to the requirements of UB's academic integrity policy.

Policies and Procedures:
1. There will be no makeups of the quizzes or exams unless absence is due to a documented illness or major family problem.
2. Other completed assignments turned in late will be penalized by one grade level for each class that the assignment is late. Example: The take-home exam was due Thursday, March 3, but was not turned in until Tuesday, March 08. If handed in on time, a 'B' grade would have been given. Because it was one class overdue, the assigned grade will be 'B-'; if two classes late, a B becomes a C+.
3. All oral presentations are to be ready on Tuesday, March 22. The order of presentations will be based on a 'lottery' drawing at the beginning of each class that presentations are scheduled. If your name is drawn, and you are not present or prepared to give your presentation, the 'late clock' will start [see #2, above].
4. Disabled students will inform Dr. Baier, in writing, of their situation by Tuesday, January 25, so that appropriate adjustments can be implemented per University policies. This is your responsibility.

5. Student athletes will provide Dr. Baier with written documentation from the team coach, with their travel schedule, by Tuesday, January 25, so that appropriate adjustments can be implemented per University policies. This is your responsibility.
6. To make an appointment with Dr. Baier or Dr. Meyer, contact them directly. You also are welcome to 'drop in' to see if they are available for a meeting. It is best to call first and see whether they are in the office (110 Parker Hall; Winspear Ave. side of campus), the lab (308 Squire Hall; Dental School building with red window frames, near Metro subway station), or available at a later time.

Thank you for registering for this course. We look forward to learning with you!

Example of how the final course grade will be determined
Assignment Assignment Letter Grade Assignment Quality Points Contribution of Assignment to Course Grade Quality Points Toward Course Grade
Drawing/Diagram B 3.00 5% 0.15
Oral Presentation A 4.00 10% 0.40
Annotated Resources B 3.00 15% 0.45
Take-Home Exam A- [1 class late] 3.67 15% 0.55
Quiz 1 C 2.00 5% 0.10
Quiz 2 B 3.00 5% 0.15
Quiz 3 F [absent] -0- 5% 0.00
Quiz 4 A 4.00 5% 0.20
Quiz 5 B 3.00 5% 0.15
Final Exam B 3.00 20% 0.60
Attend/Participate B 3.00 10% 0.30
Total Quality Points Earned in This Example 3.05
Final Course Grade* B+
Final Quality Points Awarded for This Grade 3.33
* Total Quality Pts Earned Final Course Grade Total Quality Pts Earned Final Course Grade
3.68 - 4.00 A 2.01 - 2.33 C+
3.34 - 3.67 A- 1.68 - 2.00 C
3.01 - 3.33 B+ 1.34 - 1.67 C-
2.68 - 3.00 B 1.01 - 1.33 D+
2.34 - 2.67 B- 0.50 - 1.00 D
less than 0.50 F

UGC 302BAI: Science - Microworld: Medical Implant Controversies Spring 2011
20jan2011 ? Silicones 1: breast implants, brain shunts

25jan2011 ? Self v. nonself: immune system; cancer; implants
27jan2011 - Types of materials implanted into people
LAST DAY OF DROP/ADD PERIOD IS FRIDAY, JANUARY 28
01feb2011 ? Assignment of topics in anatomy and physiology
- Silicones 2: jaw joint discs, heart valve balls
03feb2011 ? Quiz #1 [5%]
? Receive take-home exam
- Jaw joint implants; Teflon
08feb2011 ? Heart valves: successes and failures 18jan2011 ? Introductions and overview
15feb2011 ? Testing in animals
17feb2011 ? Quiz #2 [5%]
? Artificial internal organs
22feb2011 ? Diagram of assigned system due [5%]
? Artificial hips and knees
- How 'strong' or 'durable' is a material? 24feb2011 ? Medical devices: who 'owns' implants?
01mar2011 ? Ethics of implantation
- What is the role of the media? 03mar2011 ? Take-home exam due [15%]
? Clinical studies & regulation of medical devices
08mar2011 ? Quiz #3 [5%]
- Infection control: history & current approaches
- Mad Cow Disease 10mar2011 ? Catheters

- Device-centered infection
MARCH 14-19, 2011 ? NO CLASSES (UB'S SPRING RECESS)
22mar2011 ? Presentations [10%]
24mar2011 ? Presentations, continued

29mar2011 ? Presentations, continued
31mar2011 - Presentations, continued

05apr2011 ? Quiz #4 [5%]
? Cloning, genetic engineering
07apr2011 ? Birth control implants and skin patches
- Intrauterine devices
12apr2011 ? Biomimetics and nanotechnology 14apr2011 ? Implantable ceramics
- Contact lenses & implanted lenses for better vision
19apr2011 ? Quiz #5 [5%]
? Artificial blood 21apr2011 ? [Class determined]

26apr2011 ? ? Annotated resources due [15%]
- [Class determined] 28apr2011 ? preparation for final exam ? full class participation
Attendance/participation [10%]
Final exam [20%] will be given during scheduled final exam week (May 5- May 12, 2011).

Conference Proceedings

Categories for which nothing is reported:

Any Conference

THE UNIVERSITY OF MEMPHIS
Department of Physics
M. Shah Jahan, Professor-Chair
IUCB Activity Summary for the Calendar Year 2010

Advising/Mentoring (research)

BS: Virgil Donaldson (ME)
MS: Dereje Abdi (Physics)
Ph.D. Malik Mehmood Sajjad (visiting scholar from Pakistan Institute of Engineering & Applied Sciences)

Awards/Recognitions

- Nominated for The University of Memphis Board of Visitors 2010, 2011--Eminent Faculty Award
- 30-year Service Award
- Recognition by UM Alumni Association as a longest-term donor to University Fund

Research Collaboration

Dr. Luke Boatright, Professor, Department of Animal and Food Sciences, University of Kentucky, Lexington, KY.

Center for Free Radical Research and Service (CFFRS), a byproduct of IUCB

Jahan directs and manages a Free Radical Testing Center (FRTC). A full time Research Tech is employed to run this revenue earning center which has been in operation since 1995. The current clients of FRTC are medical-device industries, medical-grade polymer industries and biomedical research institutes.

Outreach Activity

Local medical industries; InMotion (Memphis Musculoskeletal Research Institute); BioWorks Group. Provided research opportunity for TLSAMP students.

Invited Talk

Presented an invited talk at the 9th International Symposium on Ionizing Radiation and Polymers (IRaP) held on Oct. 25-29, 2010, at the University of Maryland, MD USA

SCHOLARSHIP/CREATIVE ACTIVITIES

Book Chapter

new initiative in food science

Boatright W.L. and M.S. Jahan, 2010. Carbon-Centered Radicals in Soy Protein Products. In K.R. Cadwallader and S.K.C. Chang (Eds.), Chemistry Texture and Flavor of Soy (pp. in press). American Chemical Society, Washington, DC.

Refereed Publications

1. Jahan, M.S., Walters B.M., Macro radical reaction in ultra-high Molecular weight in the presence of vitamin E. Radiat. Phy. Chem. 62, 141-144, 2010.
2. Malik S. Mehmood, Jahan M. Shah, Sanjay R. Mishra and Benjamin M. Walters, The effect of high dose on residual radicals in open air irradiated α -T UHMWPE resin powder, Radiat. Phy. Chem. (submitted).

new initiative in food science

3. Lei Q., C.M. Liebold, W.L. Boatright and M.S. Jahan,. Distribution of Stable Free Radicals among Amino Acids of Isolated Soy Proteins, Journal of Food Science, 75(7):C633-640 (2010).

Conference Presentations (student co-authors highlighted)

International Conferences

1. **Malik S. Mehmood**, Jahan M. Shah, Sanjay R. Mishra and Benjamin M. Walters, The effect of high dose on residual radicals in open air irradiated α -T UHMWPE resin powder, 9th International Symposium on Ionizing Radiation and Polymers (IRaP 2010), 25-29 Oct., 2010, University of Maryland, USA.
2. Invited. Jahan M. Shah, **Malik S. Mehmood** and Benjamin M. Walters, Radiation Dose Dependant Electron Spin Resonance (ESR) signals in Ultra-High Molecular Weight Polyethylene, 9th International Symposium on Ionizing Radiation and Polymers (IRaP 2010), 25-29 Oct., 2010, University of Maryland, USA.

National Conferences

1. Benjamin M. Walters, **Virgil Dononldson*, Ephasia Goodall**** and M. Shah Jahan, **Observation of slowed reaction of polyethylene radicals in presence of vitamin E,** 35th Annual Meeting of the Society for Biomaterials, Seattle, Washington, 2010**.**

- *Virgil Donaldson (African American male, ME major), TLSAMP participant.
- **Ephasia Goodall (African American female), REU participant from Lane College, Jackson, TN).

new initiative in food sciences

2. Boatright W.L. and M.S. Jahan, Formation and Reactivity of Carbon Centered Radicals in Soy Proteins, USDA *NRI Project Director's Meeting and Institute of Food Technologists Annual Meeting Technical Program Book of Abstracts*, Chicago, IL, July 2010.
3. Lei Q., C.M. Liebold, W.L. Boatright and M.S. Jahan, Distribution of Stable Free Radicals among Amino Acids of Isolated Soy Proteins, *Institute of Food Technologists Annual Meeting Technical Program Book of Abstracts*, Chicago, IL, July 2010.
4. Liebold C.M., Q. Lei, W.L. Boatright and M.S. Jahan, Hydration Induced Chemiluminescence and Protein Structure Modifications in ISP, *Institute of Food Technologists Annual Meeting Technical Program Book of Abstracts*, Chicago, IL, July 2010.

Grants and Contracts

PROJECT/ACTIVITY	AGENCY/SOURCE	AMOUNT	PERIOD
Carbon-Centered Radicals in Isolated Soy Proteins	USDA/Univ. KY	169,000	12/08-12/11
Focused Reserach	Biomet	$95,000	6/09-5/11
ESR Service (Revenue)	Industries/Institutions	$95,000 (apprx.)	2010
Free Radicals in UHMWPE	Zimmer	$40,000	12/10-02/12
Free Radical Test	Cambridge Polymer Group	$70,000	02/11-02/12

SERVICES

University: ▪ Radiation Safety Committee
▪ Judicial Affairs committee

National: ▪ Bylaws Subcommittee, Society for Biomaterials

Conference Organizer: ▪ Scientific Program Committee, International Symposium on Ionizing Radiation and Polymers (IRaP).

Visitor to IUCB Center for Free Radical Research and Service (CFFRS)

1. Jordan Freedman, Biomet
2. Stephen Spiegelberg, Ph.D., President, Cambridge Polymer Group
3. Gavin Braithwaite, Ph.D., Vice President, Cambridge Polymer Group