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The Department of Chemical and Biochemical Engineering

Departmental Affairs

On June 30, 2011, Professor Henrik Pedersen stepped down as Chair of the Department, a position he held for the last nine years. Professor Mauricio Futran was appointed as the new Chair of the Department to succeed Prof. Pedersen. Dr. Futran has an impressive record as an executive in the pharmaceutical industry where he served for 27 years including twelve as Vice-President, Process Research and Development of Bristol-Myers Squibb Company. Previous to his service at BMS, he was Senior Director, Chemical Engineering Research & Development of Merck and & Co., Inc. He has Chemical Engineering degrees from Rice and Princeton Universities and serves on the advisory boards of the Chemical Engineering Departments at Georgia Tech and Princeton. Dr. Futran was elected to the National Academy of Engineering in 2003 for technical leadership in pharmaceutical process design and development, especially in the engineering of Crixivan®, an HIV protease inhibitor.

Faculty Affairs

On January 1, 2011, Dr. Stavroula Sofou joined the Department as Associate Professor. She holds a joint appointment with Biomedical Engineering. Prof. Sofou received her Diploma in Chemical Engineering from the National Technical University of Athens, Greece, and her Ph.D. degree in Chemical Engineering from Columbia University with “distinction” for her thesis. Her research interests are in heterogeneous biomembranes, environmentally responsive lipid vesicles, transport limitations in liposomal chemotherapy to solid tumors, alpha-particle therapy of cancer, integrated strategies for targeted liposome-based cancer chemotherapy and internal radiotherapy of cancer.

On July 1, 2011, Dr. Meenakshi Dutt joined the Department Assistant Professor. Her research interests are in the areas of particle technology, static, fluidized and compressed powder beds, bio and hybrid materials, biomimetics, reactive flows through porous media, and mesoscopic simulation techniques. Prof. Dutt received her B.S. degree in Physics, from the University of Delhi, India, in 1994, her M.Sc. in Physics, from the Indian Institute of Technology, in 1996 and her Ph.D. in Physics from Duke University in 2002.
Productivity

The productivity of the faculty is evidenced by the high level of research activity and publications generated within the Department: there are a total of 71 on-going sponsored projects, ranging in length from one to five years. The total dollar value of these grants amounts to $44.8 million. The research expenditures for the 2011 calendar year were approximately $9 million.

During this calendar year, the faculty and students produced a total of 121 journal publications (98 in print and 23 in press). In addition, they presented 90 technical papers at conference meetings and 55 invited lectures at universities and industry.

Faculty Awards and Professional Recognition

Prof. Yee Chiew was chosen by the graduating senior class of the Chemical and Biochemical Engineering Department as the recipient of the Teaching Excellence Award for the year 2010-11. This award was presented to Dr. Chiew at the annual post-graduation reception on Commencement Day, May 15, 2011.

Prof. M. Silvina Tomassone received the Teacher of the Year Award for excellence in teaching during the Spring and Fall 2011 semesters. This award is coordinated by the Rutgers Engineering Governing Council with voting by the Chemical and Biochemical Engineering students.

Prof. Teddy Asefa was honored with the NSF Special Creativity Award from the Division of Materials Research of National Science Foundation (NSF) for his work related to the development of novel nanoceramic materials.

Prof. Charles Roth directs a successful Research Experiences for Undergraduates (REU) program in Cellular Bioengineering. Funded by the National Science Foundation, this program is in its second year with 10 participants each year coming to Rutgers from external institutions.

Prof. Yee Chiew has been appointed Associate Dean for International Programs, School of Engineering. He will be coordinating the efforts in expanding the international agenda for the School which include enhancing the existing and creating new global partnerships in education and research with universities overseas.

A paper recently co-authored by Prof. Alex Niemark on the topic of “Stress-Based Model for the Breathing of Metal–Organic Frameworks” was selected as a Hot Paper with Narrations by the Journal of Physical Chemistry Letters.
Professor Ierapetritou has been selected as a recipient of the 2012 Outstanding Faculty Award. This award recognizes SOE faculty for excellence in research, teaching and service. The formal recognition will be conferred at the Medal of Excellence dinner on February 24.

### Student Affairs

#### Degrees Granted

The Undergraduate Program of the Department graduated sixty-three students with the degree of Bachelor of Science in Chemical Engineering. Among the sixty-three graduates, fifty-five pursued the Chemical Engineering option and eight chose the Biochemical Engineering program. Four of these graduates were designated James J. Slade Scholars.

In the 2010-11 academic year, the Graduate Program of Chemical and Biochemical Engineering graduated two students with the M.S. degree, two students with the M.E. in Pharmaceutical Engineering and Science degree, and nine students with the Ph.D. degree.

Since 1964, the year of the Department’s first graduating class, a total of 2132 B.S. degrees have been granted. The Graduate Program has awarded 492 M.S. degrees and 250 Ph.D. degrees.

#### Professional Employment

The employment opportunities for this year’s graduates were adversely affected by the state of economy. A survey conducted at the end of the Spring semester showed that, of the sixty-four graduating seniors, 14 had offers for full-time positions in industry and 13 were planning to attend graduate school. The starting salaries for the B.S. degree in chemical and biochemical engineering were in the range of $41,000 to $78,000 per year.

#### Student Awards and Honors

The quality of the students graduating with the B.S. degree in the Department in 2011 remains high as reflected by the high percentage (56%) of students graduating with honors: Thirty-three of the B.S. degree recipients graduated with the “Honors” designation (fifteen received “Highest Honors,” five were given “High Honors,” and thirteen were in the “Honors” category). In addition, four students completed the James J. Slade Scholars Program.

#### Alumni Relations

We have renewed our efforts to stay in touch with the alumni of the Department. We put together the Fall 2011 issue of the Alumni Newsletter which was sent to a total of 2500 alumni. In addition, we established two groups of Rutgers Chemical & Biochemical Engineering Alumni, one on Facebook and one on LinkedIn, with a total membership of about 900 alumni. The latter group is an officially chartered member organization of the Rutgers University Alumni Association.

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Reception at the AIChE Meeting

We organized and participated in a reception for alumni and friends of the Department at the Annual Meeting of the AIChE in Minneapolis, MN, in October 2011. This year’s reception was attended by approximately 200 alumni, friends, and colleagues from other Universities.

Graduate Education and Research

The graduate education and research thrusts of the Department are in the areas of chemical engineering science, process systems engineering, multiscale modeling and simulation, pharmaceutical engineering and manufacturing, biotechnology and biomolecular engineering, systems biology, drug delivery, biomanufacturing, nanomaterials, reaction science and catalysis, and polymer science and engineering. These thrusts are interconnected and interdisciplinary, leading to research activity in several areas that are at the leading edge of technology.

Biotechnology and Bioengineering

Research involves developing fundamental physicochemical understanding of biological processes as a basis for the design of clinically and industrially important products and processes. This is accomplished by bringing to bear principles of engineering, physics, and chemistry on the fields of molecular and cellular biology and biomedicine. Current research topics include stem cell and tissue engineering, cell-biomaterial interactions, biologically targeted formulations for drug and gene delivery and intracellular imaging, systems and computational biology for the analysis and simulation of genetic networks, genomics, proteomics, bioinformatics. Complementing the research efforts in this area are a NSF funded IGERT PhD Training Program on Science and Engineering of Stem Cells and a long-standing NIH-sponsored Ph.D. training program in Biotechnology, now in its 23th year. Graduate students in this area can also mentor undergraduate researchers as part of the NSF funded Research Experience for Undergraduate (REU) on Cellular Bioengineering.

Pharmaceutical Engineering

Research focuses on a broad spectrum of problems in the design and optimization of manufacturing processes for efficient and environmentally benign production of pharmaceutical products. Current research addresses unit operations used to manufacture solid dose forms such as tablets and capsules, including crystallization, drying, blending, sampling, granulation, and compaction. The goal is to make such processes more reliable and productive. A graduate training program in pharmaceutical engineering, a center grant from the National Science Foundation, a fellowship grant from the Department of Education and a significant amount of industrial matching funds support efforts in this area. A new curriculum to provide focused training in pharmaceutical engineering at the Masters level was initiated recently.
**Liquid Mixing and Powder Blending**

The main goal of the mixing laboratory is to apply concepts from dynamical systems theory to the analysis and optimization of industrially relevant mixing processes. The systems considered in this research include viscous, non-Newtonian fluids, dry powders, and slurries. Several industrially relevant mixing systems are currently examined, including stirred tanks, static mixers, impinging jet mixers, roller bottle bioreactors, cascade impactors, and tumbling blenders. Approaches used to enhance mixing in these systems include tracer visualization, particle imaging velocimetry, laser-induced fluorescence, 3D imaging of powder mixtures, finite volume and discrete element computer simulations, and dynamical systems theory.

**Reaction Engineering**

The department has an active program in reaction engineering and catalysis focused on the modeling of complex reactions, chiral synthesis of drugs, and high performance simulation of reactive systems. A new areas of focus is the multi-scale approach to modeling catalytic reactions in porous media ranging from the particle scale molecular modeling to process level simulations.

**Polymer Science and Engineering**

The polymer science and engineering group within the Department is involved in finding innovative solutions to technologically relevant problems using concepts from polymer chemistry, polymer physics, and polymer materials science. Some examples of recent projects are: polypeptide ionomers, ionic molecular composites, multilayered ionomer films of nm-layer thickness, metal and semiconductor nanoclusters formed in ionomer matrix, piezoelectric polymer blends, piezoelectric and electrostrictive polymers for use as sensors, actuators, transducers, and haptic interfaces, molecular interpretation of chain dynamics at polymer interfaces, fractionation/selective dissolution of litho-graphically attractive novolaks, electrodeposition of nanoparticles, use of piezoelectric biopolymer substrates to deliver time varying electric fields to growing neurons controlling cell growth and plasticity.

**Multiphase Flows**

Research is concerned with developing a fundamental understanding of multiphase and particulate flows and applying this understanding to improve the design of chemical and pharmaceutical processes. The mechanics of these systems are studied through combined numerical, theoretical, and experimental efforts. Novel computational approaches to particle and molecular dynamic simulations combined with experiments on model systems are carried out to explore the physical mechanisms governing the flows. High performance computing is used together with modeling to obtain specific predictions on flows of practical interest. Recent advances in bifurcation analysis, and nonlinear dynamics allow systematic examination of stability and multiplicity of solutions.
Research in this area focuses on the development of computer-aided tools for addressing design and operations issues arising at various stages of product and process design and process operations by developing and analyzing efficient models and solution methodologies. Specific issues of interest include short-term scheduling, planning and supply chain management of batch and continuous industrial plants, the incorporation of uncertainty introduced by approximate models, the consideration of environmental performance measures into the early process and product design stages, the use of alternative materials featuring desired properties, and sustainable manufacturing. Issues related to metabolic engineering and efficient pharmaceutical product development and manufacturing are also considered.

Research in nanotechnology ranges from studies elucidating physical processes at the nanoscale and applying the outcomes for the development of technologically relevant processes and product concepts. Areas of application range from efficient energy storage, conversion, and harnessing; separation processes; and biological drug delivery and tissue targeting and imaging. Nanotechnology addresses the growing challenges in catalysis and the advanced materials applied to drug delivery and biomedicine. Current thrusts in this area encompass the self-organization of nanoparticles in synthetic and bio-polymeric materials, the design of biomimetic synthetic polymeric materials and nanostructured biomaterials via spontaneous and directed-assembly using mesoscopic computational techniques. Nanotechnology forms a major core within the NSF funded Engineering Research Center.

Computational molecular design of novel functional materials and optimized manufacturing operations has been rapidly developing into a striving interdisciplinary field of modern chemical and biochemical engineering. It is now well understood that the engineering properties of functional materials are determined by the underlying nanoscale physico-chemical mechanisms and can be tailored and optimized by varying the nanostructure morphology and nanoscale interactions. Computational molecular design of nanostructured materials requires a combination of various theoretical and simulation methods. These materials, such as adsorbents and catalysts, ion-exchange membranes and molecular sieves, pharmaceutical and personal care products, as well as various biomaterials, often possess a hierarchical structure. Being parts of macroscopic devices, they are built on nanoscale blocks which are commonly arranged in self-assembled microscopic structures. The hierarchical structure of nanomaterials implies a hierarchical structure of a suite of modeling tools, which span many orders of magnitude of spatial and temporal scales.

Our department has accumulated over the years the unique expertise in various molecular simulation and computational techniques (Dr. Neimark,
statistical mechanics, multiscale simulations, and fluid density functional theory; Dr. Vishnykov, general computational chemistry, Monte Carlo Molecular Dynamics, and Dissipative Particle Dynamics; Dr. Chiew, molecular thermodynamics of solutions and polymers; Dr. Tomassone, molecular dynamics; Dr. Ierapetritou, system optimization). With the recent arrival of Dr. Dutt (particle dynamics and high performance computing), Dr. Ramachandran (multi-dimensional modeling of manufacturing processes), and Dr. Futran (lattice gas molecular simulations and pharmaceutical product design), a critical mass has been achieved to distinguish the computational molecular design as one of the core departmental expertise thrusts. This thrust serves as a foundation for further development and expansion of traditional research competencies of CBE department, such as pharmaceutical manufacturing, nanostructured materials synthesis and characterization, life science and biomedical engineering. Also, the computational modeling should play an increasing role in student education on both undergraduate and graduate level.
Faculty Summary
Ioannis P. Androulakis  
Associate Professor

Degrees  
B.S., Chemical Engineering, National Technical Univ., Greece, 1988  
Ph.D., Chemical Engineering, Purdue University, USA, 1993

Interests  
Systems biology of inflammation  
Complex systems modelling and analysis

Accomplishments

Professor Androulakis runs a successful research program with a focus on the systems biology of inflammation in the context of traumatic injury. He holds appointments in the Chemical & Biochemical Engineering Department, the Biomedical Engineering Department, the Graduate Program of Quantitative Biology. He is also an Affiliated Faculty with the Center for Engineering in Medicine and he holds and Adjunct Associate Professor Position with the Surgery Department at the Robert Wood Johnson Medical School. Prof. Androulakis also serves as the Vice-Chair and Undergraduate Program Director in the Biomedical Engineering Department.

Prof. Androulakis’s research group is composed of seven PhD students and three undergraduate assistants. Prof. Androulakis has published over 100 scientific papers and has edited numerous book chapters. He joined Rutgers in 2004 after nine years with ExxonMobil’s Corporate Strategic Research Laboratories and prior to that as a post-doctoral fellow at Princeton University.

His research focuses on two main areas: (i) rat models of burn/sepsis; (ii) human model of endotoxemia. Through a combination of experimental and theoretical work he attempts to decipher the complexities of the onset and resolution of the inflammatory response under traumatic stress. His work if supported by the NIH, NSF, EPA and ONR.

Prof. Androulakis has established ground-breaking research through extensive collaborations with clinical scientists in an attempt to develop systems biology representations of systemic alterations, at the heart rate level, of acute stress. He was among the first to establish multi-scale models of human endotoxemia linking pathogen recognition at the cellular
collaboration with Robert Wood Johnson, and University of Pittsburgh Medical Center. He is currently editing a special volume of the Journal Critical Reviews on Biomedical Engineering with focus on inflammation modelling.

As an educator Prof. Androulakis has contributed, in addition to introducing novel courses, such as the first Systems Biology course in the School of Engineering, he has completely restructured the Senior Design course in Biomedical Engineering establishing links between education and Innovation. He is actively participating in undergraduate research experiences either through advising or participation in REU programs.

He is a member of several School of Engineering committees, in addition to serving in the graduate admissions committees of the Chemical Engineering and Biomedical Engineering Departments, being the vice-chair and Undergraduate Director in BME well as serving in the Courses of Study Committee of the School of Engineering.

Since joining Rutgers in 2004, he has graduated a number of students who have all gone to pursue excellent opportunities. His students have joined companies such as ExxonMobil and Johnson & Johnson, been awardeer prestigious awards, such as the Excellence in graduate studies from the School of Engineering, the Kierkshtein Fellowship from NIH or have pursue post-doctoral appointments at outstanding places such as Harvard Medical School, Mt Sinai Medical School, UC Santa Barbara and SUNY Buffalo (Pharmaceutics).


**Publications**


Invited Lectures


Presentations


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<th>John Mattick, Jeremy Scheff, Pantelis Mavroudis, Qian Yang, Shuliang Zheng, Nguyen Tung, Vassilis Niotis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate Students</td>
<td>Rashesh Shah, Mary Shelman, Aditya Sai</td>
</tr>
</tbody>
</table>
**Tewodros (Teddy) Asefa**  
*Associate Professor*

**Degrees**  
B.S., Chemistry, Addis Ababa University, Ethiopia, 1992  
M.Sc., Chemistry, SUNY at Buffalo, USA, 1998  
Ph.D., Materials Chemistry, University of Toronto, Toronto, Canada, 2002

**Interests**  
Nanoscience and nanotechnology; inorganic materials chemistry; nanocatalysts and nanocatalysis; nanomedicine and targeted treatment of cancer; shaped nanoparticles and their self-assembly; nanoporous materials; nanoelectronics; nanomaterials for solar cells and renewable energy; inorganic-organic nanocomposites; and nanobiomaterials. Enjoys challenging and collaborative research.

**Accomplishments**  
After a successful four years as an Assistant Professor of Chemistry and Biochemistry at Syracuse University, Teddy was recruited by Rutgers University at New Brunswick. He joined Rutgers in the summer of 2009 as an Associate Professor, with a joint appointment in the Department of Chemistry and Chemical Biology, and the Department of Chemical and Biochemical Engineering. He was also offered affiliations with the Rutgers Institute for Advanced Materials, Devices and Nanotechnology (IAMDN) and the Rutgers Energy Institute (REI). These two institutes, IAMDN and REI, provide support and coordination for a group of researchers including myself, who are involved in research programs in the areas of nanoscience and nanotechnology, energy and environment, electronics, photonics, sensors and biosensors, and nanomedicine. In collaboration with several other IAMDN’s members, he has been actively working on many of these research activities to contribute to IAMDN’s missions. He also uses a number of state-of-the-art nanoscale characterization facilities that IAMDN manages.

After coming to Rutgers, he has continued to make contributions to the fields of nanomaterials synthesis, nanotechnology, catalysis, and nanobiotechnology. His research interests at Rutgers continued to focus on the design, synthesis, and self-assembly of novel inorganic nanoporous and nanostructured materials and nanobiomaterials having unique catalytic, biological, and photoelectronic properties. His research group continues to engage in research that aims to address several challenging problems.
facing society including the development of novel catalysts for efficient production of fine chemicals and synthetic materials, and developing nanomedicine for the effective treatment of various diseases, including cancer. In addition, he has recently started a major new research program to develop novel nanomaterials that potentially enable making renewable energy from CO₂.

Teddy has been successful in obtaining for my research over ten research grants so far, including a Career Development Award from the NSF (2007-2012), six others from NSF, three more from the Environmental Protection Agency through the Syracuse Center of Excellence in Environmental Systems, and a grant from O’Brien & Gere. In addition, he was also a major contributor and a Co-PI on two successful proposals to the NSF for the acquisition of an atomic force microscope while at Syracuse and the acquisition of a solid state NMR instrument at Rutgers. He has many ongoing federally funded research programs at Rutgers.

Teddy has made significant contributions to nanomaterials science, catalysis, nanotechnology, and nanobiotechnology over the last few years now. His research group developed several novel synthetic routes to novel nanomaterials, investigated their physical and chemical properties, and potential applications. His work in the last few years had substantial impact in a diverse set of fields, as indicated by publications in many high profile journals.

As an independent PI, he has published over 42 peer-reviewed articles in leading journals in chemistry, catalysis, biochemistry, and materials science. He has over ten more articles under revision, in submission, or near completion. He has also published three invited book chapters, have three more in preparation, and I am currently co-editing a book for Wiley. In addition, he has filed five patent applications in the last six years as PI.

His overall work has been cited over 2,800 times, putting his #11 in ranking of all faculty members in the School of Engineering at Rutgers, in terms of average citations per paper. The projects that he has pursued as a PI since 2005 can be divided into four groups below:

(i) Developing new synthetic strategies to multifunctional nanocatalysis and investigation of their catalytic and biocatalytic properties (>30 publications)
(ii) Developing novel nanomaterials for controlled delivery of to targeted cells/tissues and biosensing (>21 publications)
(iii) Nanomaterials for solar cells (> 5 publications)
(iv) Miscellaneous (5 book chapters, 1 book in preparation, and 2 review papers)

His research work have been presented in many national and international
He is engaged in continued collaborations with over a dozen other research teams at Rutgers, Syracuse, and overseas. These include Profs. Dunbar Birnie (Materials Science and Engineering Dept., Rutgers); Jing Li (Chemistry Dept., Rutgers); Detlef Smilgies (CHESS, Cornell); Chris Howarth and Abdul-Kader Souid (University of UAE); Eric Schiff (Physics Dept., Syracuse); Mark Bowick (Physics Dept., Syracuse); Jim Dabrowiak (Chemistry Dept., Syracuse); Gadi Rothenberg (University of Amsterdam, The Netherlands); Jerry Goodisman (Chemistry Dept., Syracuse); Charles Dismukes (Chemistry Dept., Rutgers); Alan Goldman (Chemistry Dept., Rutgers); Robert Niederman (Biochemistry Depart., Rutgers); Marina Petrukhina (Chemistry Dept., SUNY–Albany); Vivek Polshettiwar (KAUST); Evgeny Dikarev (Chemistry Dept., SUNY–Albany) and Frank Zimermann (Physics Dep., Rutgers).

**Publications**


C. Howarth; T. Asefa, and A-K. Souid, “Interactions and Biocompatibility of Mesoporous Silica Nanoparticles with Rat Ventricular Myocytes for Cardiac Treatment” Small, To be Submitted.


**Presentations**


Invited Speaker, 9th International Nanomedicine and Drug Delivery Symposium, NanoDDS’11, Salt Lake City, UT, October, 2011.


Oral Presentation, 85th ACS Colloid and Surface Science Symposium, Montreal, Quebec, Canada, July 2011.

Keynote Lecture, Omega Chi Epsilon (the American Honor Society for Chemical Engineering Students) induction, Rutgers University, Piscataway, NJ, Spring 2011.

Invited Lecture, Nanomaterials Class, Materials science and Engineering Department, Rutgers University, Piscataway, NJ, Spring 2011.

Invited Lecture, Nanomedicine Class, Biomedical Engineering Department, Rutgers University, Piscataway, NJ, Spring 2011.

**Supervised Graduate Students**

Sayantani Das, Saquib Ahmed (Co-Supervised with Prof. Dunbar Birnie in MSE at Rutgers), Rafael da Silva, Vidyalakshmi Muthukumar, Rachit Jain, Flavian Patrao, Gang Wang (Currently a PhD Student in Department at Syracuse University; Expected to defend in December 2011), Cole Duncan (Completed PhD thesis in July 2010 at Syracuse University), and Dr. Krishna K. Sharma (Completed his PhD thesis in January 2010 at Syracuse University)

**Undergraduate Students**

Stephanie Hayes, Dhara Patel, Nicholas Pasquale, Peter Lobaccaro, Mukund Patel, and Yesha Kathrani
Yee C. Chiew
Professor

Degrees
B.S., Chemical Engineering, University of Edinburgh, 1979
Ph.D., Chemical Engineering, University of Pennsylvania, 1984

Interests
Complex fluids, soft matter, and nanocolloids
Thermodynamics and solubility of pharmaceuticals and biologics

Accomplishments
Professor Yee Chiew continues to make significant contributions to the Department in the areas of teaching, research and service. In the Spring semester, he taught the graduate level core course 155:514 Kinetics, Catalysis and Reactor Design. This course reinforces key concepts and theories of kinetics and catalysis and equips graduate students with the tools to design complex reactor systems. In the summer, Prof. Chiew taught the sophomore-level course 155:208 Chemical Engineering Thermodynamics I. This is one of the core Chemical & Biochemical Engineering foundational courses and students take this as preparation for the Thermodynamics II course in their junior year. Professor Chiew supervised two undergraduate students in Special Problems in Chemical and Biochemical Engineering and one J. J. Slade Scholar student. One undergraduate student, Joey Vella, working with Prof. Chiew, won the best poster paper award in the Department’s Undergraduate Research Symposium in Spring 2011. Professor Chiew has made significant contributions to teaching and mentoring of undergraduates and was recognized for the Department’s 2011 Excellence in Teaching Award.

Prof. Chiew research has focused on molecular thermodynamics of complex fluids and nanocolloids, and solubility and thermodynamic properties of pharmaceutical products. In the past few years, he and his students have developed thermodynamic models and simulation methods to estimate the solubility of pharmaceutical drugs in liquid and supercritical solvents. They have focused their efforts on three drug compounds: lovastatin, simvastatin and artemisinin. Activity coefficient models and solubility parameters for these compounds have been obtained for the first time. His research team is developing simulation methods to estimate the solubility of drug and organic compounds through molecular dynamics and free energy perturbation methods.
Prof. Chiew directs a U.S. Department of Education funded GAANN Fellowships for Pharmaceutical Engineering Program which, in its third year, has supported and continues to support Ph.D. students in the department. In this past year, Prof. Chiew supervises two graduate students. He continues his collaborative work with colleagues from the Nanyang Technological University of Singapore on modeling the solubility of pharmaceutical products.

During this year, he has been active as a reviewer for several international engineering and scientific journals: Journal of Chemical Physics, Industrial & Engineering Chemistry Research, Journal of Molecular Liquids, Chemical Physics, Journal of Physical Chemistry, Fluid Phase Equilibria, Biochemical Sciences, and Ionics.

During the year, Prof. Chiew served as Director of Graduate Program in Chemical and Biochemical Engineering until he was appointed Associate Dean for International Programs of the School of Engineering in February 2011. In his role as Graduate Program Director, Prof. Chiew coordinated the graduate program of the department. He introduced and developed the combined 5-year BS/MS program in chemical and biochemical engineering. In addition, he developed the chemical engineering concentration for the Masters of Business Science program.

In his role as Associate Dean for International Programs, he has played a major role in coordinating the efforts in expanding the international agenda for the School which include enhancing the existing and creating new global partnerships in education and research with universities overseas, increasing the opportunities for SOE undergraduates to study abroad to enhance their global study experiences, supporting international exchange and visiting activities. He has initiated cooperative education programs with South China University of Technology, China, and Bahcesehir University, Turkey. Professor Chiew served as a member of the Graduate Admissions Committee of the Department of Chemical & Biochemical Engineering. He is a member of the Physical and Mathematical Sciences & Engineering Area Committee of the Graduate School of New Brunswick. At the university level, he is a member of the International Advisory Committee and Rutgers-in-China Strategy Committee.

**Invited Lecture**

**Supervised Graduate Students**
Sarang Oka, Fabian Casteblanco

**Undergraduate Students**
Joey Vella, Derek Sturm
Alkis Constantinides  
**Professor & Director of Alumni Relations**

**Degrees**  
B.S., Chemical Engineering, Ohio State University, 1964  
M.S., Chemical Engineering, Ohio State University, 1964  
D.E.Sc., Chemical Engineering, Columbia University, 1970

**Interests**  
Applied numerical methods  
Process design

**Accomplishments**  
During the calendar year 2011, Professor Constantinides taught four undergraduate courses: the junior-level “Design of Separation Processes” and “Chemical Engineering Analysis II”, and the two-semester senior-level sequence “Chemical Engineering Design and Economics I & II”. A total 250 students attended these four courses.

As the Director of Alumni Relations, Prof. Constantinides intensified his activities in staying in touch with the alumni of the Department. He put together the Fall 2011 issue of the Alumni Newsletter which was mailed (or emailed) to a total of 2500 alumni. In addition, he established two groups of Rutgers Chemical & Biochemical Engineering Alumni, one on Facebook and one on LinkedIn, with a total membership of about 900 alumni. The latter group is an officially chartered member organization of the Rutgers University Alumni Association.
Meenakshi Dutt  
Assistant Professor

**Degrees**
- B.S., Physics, University of Delhi, India, 1994  
- M.Sc., Physics, Indian Institute of Technology, India, 1996  
- Ph.D., Physics, Duke University, United States, 2002

**Interests**  
- Particle technology, static, fluidized and compressed powder beds  
- Bio- and hybrid materials, biomimetics  
- Reactive flows through porous media  
- Mesoscopic simulation techniques: discrete element method, molecular dynamics, dissipative particle dynamics, kinetic monte carlo, lattice boltzmann

**Accomplishments**
Prof. Meenakshi Dutt joined Rutgers in July 2011, and is setting up a research program focusing on the computational design of multifunctional hierarchical particulate and bio- and hybrid materials based-systems with relevance to pharmaceutical sciences, catalysis and biomimetic materials.

Prof. Dutt’s research focus has three thrusts: Controlling particle-scale properties to influence the static and dynamic behavior of fluidized and compressed powder beds; designing multifunctional hierarchical bio- and hybrid materials through the functional integration of organic and synthetic components; and multi-component reacting flows through hierarchical porous structures. Each research area requires the use of multiple mesoscopic computational techniques which are suitably interfaced to capture the multiscale nature of the problems.

Prof. Dutt is currently teaching one core undergraduate level course, “Chemical Engineering Thermodynamics II,” and will be teaching one core graduate course, “Analytic Methods” in the spring 2012 semester. She is also participating in Special Problems course in which she is supervising three students in undergraduate research projects and one student in a graduate research project.

Prof. Dutt is also the faculty adviser for the International Society for Pharmaceutical Engineers (ISPE) chapter at Rutgers.
**Publications**


**Invited Lectures**


**Presentations**


M. Dutt, O. Kuksenok, and A.C. Balazs, ”Guided Transport of a Transmembrane Nanochannel,” American Physical Society (APS) March Meeting, Dallas, TX, March 2011.

<table>
<thead>
<tr>
<th>Supervised Graduate Student</th>
<th>Nia Tran</th>
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<tbody>
<tr>
<td>Undergraduate Students</td>
<td>Sonali Ahuja, Diane Kao, Nicholas Song</td>
</tr>
</tbody>
</table>
Mauricio Futran  
Professor & Chair

Degrees  
B.S., Chemical Engineering, Rice University, 1976  
M.CH.E., Chemical Engineering, Rice University, 1977  
Ph.D., Chemical Engineering, Princeton University, 1985

Interests  
Pharmaceutical Process Development and Manufacturing,  
Biomanufacturing, Process Modeling and Optimization,  
Physical Property Prediction

Accomplishments  
Professor Futran came to Rutgers as Professor and Chair in July, 2011 after a 28 year career in Product and Process development in the Pharmaceutical Industry.

Professor Futran is working to invigorate the department and make it the most vibrant and collaborative it can be. The department has initiated a new focus on alumni relations, issued a newsletter, created LinkedIn and Facebook groups, and started approaching our friends for fundraising. We are also raising the profile of our seminar series, thanks to a gift from Johnson & Johnson, and will have a named lecture next year. We are looking to build on the collaborative efforts of various Faculty members in enhancing our funded research in a number of fronts: by reaching out to key companies, by seeking an FDA center at Rutgers, by pursuing the biopharma and catalysis elements of a new innovation park, and many others. We have defined our recruiting needs and identified three areas: Biotechnology (synthetic biology, protein and gene engineering, bioprocessing), Energy (building on our existing strengths in materials, manufacturing and systems), and manufacturing (System integration, sensors, biomanufacturing). We are now pursuing a first new hire in one of these areas. The department will be expanding our ME program in Pharmaceutical Engineering and will begin marketing it to Chinese and Indian students. The department has also put in place annual reviews for PhD students, defined the process for Masters students to transfer to the PhD program, and continues to engage with Undergraduates and encouraging their participation in our many student organizations (AIChE, SBE, ISPE, OXE, etc). Our students continue to excel in competitions such as the ChemE car and the College Bowl.
Prof Futran is initiating research programs in collaboration with other Faculty members in the areas of tablet dissolution, biomanufacturing, processing cellulose to sugars, solubility prediction for pharmaceuticals, and tissue substrate manufacturing. Prof Futran is also engaging with the SOE honors program as it is enhanced and re-launched, and will co-teach a leadership course within this program.

**Presentations**


Benjamin Glasser
Professor

Degrees
B.S., Chemical Engineering, U. of the Witwatersrand, S. Africa, 1989
M.S., Chemical Engineering, U. of the Witwatersrand, S. Africa, 1991
Ph.D., Chemical Engineering, Princeton University, 1996

Interests
Multiphase flows and reactors
Granular materials and particulate suspension and segregation
Nonlinear dynamics of transport processes
Pharmaceutical engineering

Accomplishments
During the past year Professor Glasser served as the Director of the Pharmaceutical Engineering Program. Professor Glasser has spearheaded efforts to develop a professional Masters of Engineering in Pharmaceutical Engineering and Science at Rutgers (http://pharmeng.rutgers.edu). Professor Glasser has worked with Professor Muzzio, the Director of the NSF Engineering Research Center on Structured Organic Particulate Systems to implement the new curriculum which trains students from engineering, pharmacy, and the life and physical sciences in pharmaceutical product design, pharmaceutical manufacturing and particle technology applied to pharmaceutical processes. Rutgers University provides an ideal environment for Pharmaceutical Engineering and Science because of its strength in pharmaceutical engineering, biotechnology, nanotechnology, biomaterials, drug delivery and its research ties with the pharmaceutical industry. The Rutgers graduate courses in pharmaceutical engineering make it possible to acquire the latest, up-to-date information and skills. The curriculum reflects the emphasis on “Process Understanding” and “Risk Based Regulation” that has been identified by the US FDA as the guiding principles for awarding licenses to manufacture and commercialize drug products in the 21st century. Most classes are taught in the evening on Busch campus (Piscataway) at Rutgers University. This makes it easy for part-time students to attend courses while continuing to work in industry.

During the year Prof. Glasser served as Director of the Rutgers Catalyst Manufacturing Science and Engineering Consortium (CMSEC). The Consortium (http://sol.rutgers.edu/catalyst) is an industrially supported
research center based in the Department of Chemical and Biochemical Engineering. While a large segment of the US industry, including the petroleum, chemical, pharmaceutical, automotive, and energy industries makes and/or uses catalysts, there has been no academic program focusing on the operations required to make catalytic materials. Thus, catalyst manufacturing processes are often designed relying on empiricism, leading to uncertain/suboptimal processes, decreased quality, and increased cost. By combining the substantial level of expertise in particle technology, optimization, multi-scale simulation, catalysis and molecular modeling available at Rutgers, the Consortium works on developing and promoting science-based methods for designing and optimizing catalyst manufacturing methods and processes such as impregnation, drying, slurry mixing, extrusion and calcination. This is integrated with a number of educational activities including research training of undergraduate students, graduate students and postdoctoral fellows in the area of Catalyst Manufacturing.

During the first part of the year, Prof. Glasser served as Chair of the the Department's Faculty Recruiting Committee, and during the year he served on the School of Engineering Advising Committee and Library Committee. Prof. Glasser continued to be involved with various aspects of the NSF Engineering Research Center on Structured Organic Particulate Systems.

During the year, two of Prof. Glasser's doctoral students received their Ph.D.s and one took an industrial position at L’oreal and one took a Postdoctoral Fellowship. Prof. Glasser's research during the past year has continued to focus on three main areas: the mechanics of gas-fluidized beds, flow and segregation of granular materials, and drying of particulate materials. Prof. Glasser has also started to work in the area of sustainable and renewable liquid fuels.

In the past year, Prof. Glasser had five publications appear in print and three articles were accepted for publication. Two additional articles were submitted to peer-reviewed journals and are still under review. In addition, nine research papers were presented at technical conferences and three invited talks were presented at companies. Prof. Glasser served as a reviewer for AIChE Journal, Physics of Fluids, Chemical Engineering Science, and Powder Technology

**Publications**


*Presentations*


**Invited Lectures**


**Supervised Postdoctoral Researchers**

Dr. Xue Liu, Dr. Nirmal Thyagu, Dr. Nicolas Heigl.

**Graduate Students**

Sara Koynov, Plamen Grigorov, Mathew Metzger, Alisa Vasilenko.

**Undergraduate Students**


Masanori Hara

Professor

Degrees
B.S., Polymer Chemistry, Kyoto University, 1975
M.S., Polymer Chemistry, Kyoto University, 1977
Ph.D., Polymer Chemistry, Kyoto University, 1981

Interests
Polymer physics and chemistry
Ionomer blends and nanocomposites
Ionic polymers

Accomplishments
The research efforts of Prof. Masanori Hara are focused on the synthesis and structure-property characterization of ionic polymers and related structures. Prof. Hara’s group developed ionic liquid crystalline polymers, based on Kevlar and Vectra, where ionic groups enhance compressive properties without scarifying excellent tensile properties. His group developed molecular composites, where molecular dispersion is achieved by using ionic interactions between the reinforcing rod molecules and the matrix coil molecules. His group is the first to elucidate the molecular mechanisms of the microdeformation in the molecular composites. His group has also developed nanostructured materials by using ionomers. One is multilayered ionomer films of nm-layer thickness, where attractions between cationic and anionic ionomers are used for layer-by-layer deposition. Another is metal and semiconductor nanoclusters formed in polymer matrix by using an ionomer as a template. Through these research efforts, Hara has demonstrated the effective use of ionic groups (and ionic polymers) to create new materials. Celanese is currently supporting his research.

Prof. Hara’s research results are published in leading international polymer journals, such as Journal of Polymer Science. Hara has taught “Processing and Properties of Materials,” (the first material course designed for chemical engineering students) and “Polymer Science and Engineering II” (graduate course).
Prof. Hara has served as a reviewer of various journals, including Macromolecules, Polymer, Journal of Polymer Science, Biomacromolecules, International Journal of Plastics, Rubbers and Composites, and Polymer Science and Engineering. He has also served as a reviewer of proposals for funding agencies, including National Science Foundation, Department of Energy, Research Corporation, and National Sciences and Engineering Research Council of Canada.

**Publications**


**Supervised Visiting Professors**

Dr. Yongpeng Xue
Dr. Choggang Wu

**Undergraduate Student**

Laura Norkute
Marianthi G. Ierapetritou
Professor

**Degrees**
- B.S., Chemical Engineering, National Technical Univ., Greece, 1992
- Ph.D., Chemical Engineering, Imperial College, London, UK, 1995

**Interests**
- Process planning, scheduling, and supply chain management
- Uncertainty considerations in process design and operations
- Pharmaceutical process design and optimization
- Optimization of fuel and chemical production from biomass
- Kinetic model reduction and characterization for biofuels
- Metabolic Engineering of liver

**Accomplishments**
Prof. Marianthi Ierapetritou has developed an active research program focusing on process systems engineering and in particular modeling and optimization of complex systems. Her research interests are in the areas of scheduling, planning and supply chain management; back-box modeling; uncertainty analysis; complex model reduction; process design for pharmaceutical systems; and modeling and optimization of biological systems. Her research core is to develop models, algorithms and solution methods to address complex problems arising in many different applications.

Her research is supported by grants from NSF, NIH, EPA, PRF, ONR, and industrial funds. Her research and scientific accomplishments were recognized through several scientific awards including the NSF CAREER Award, and the Board of Trustees Research Award for Scholarly Excellence from Rutgers University. She is recognized as a Trustee of CACHE, the leading organization in Chemical Engineering community promoting computational applications.

Currently, Dr. Ierapetritou runs a research lab with 7 Ph.D. students, 1 master’s student, 1 postdoctoral fellow, and 2 undergraduate research assistants. She is a co-PI in the environmental bioinformatics and Computational Toxicology Center (ebCTC) funded by EPA. She is also an active participant, acting as a project leader, and test bed coordinator for the Engineering Research Center (ERC) at Rutgers on Organic Composites for Pharmaceutical Engineering and the PI of a major
commercialization grant targeting continuous pharmaceutical manufacturing. To date, Ierapetritou has authored 126 journal publications (20 publications in the last year), 24 conference proceeding, 125 conference presentations, and has given 45 invited talks. This has been accomplished by federal, state, and industrial research funding exceeding $10.5M. She has supervised 7 postdoctoral scientists, graduated 13 Ph.D. theses (who all obtained jobs in academia and in industry); four MS projects; and over 20 undergraduate research projects. The total number of citations for Dr. Ierapetritou's research papers numbers 1506 (Web of Science, Sep 2011) with an h-index of 19.

In parallel to and aligned with her research pursuits, Dr. Ierapetritou has been recognized as an accomplished teacher/educator and administrative leader. She received the Teaching Excellence Award from the Department of Chemical & Biochemical Engineering and has served as a Graduate Admissions Chair and as an Undergraduate Program Director. She has also served in the committee of the curriculum revision resulting in departmental curriculum reorganization and she is currently working on writing a book regarding the utilization of decomposition based methods for the solution of large scale engineering problems which will be a guide to chemical engineers seeking optimization of system’s capacity. Last year she chaired the committee for appointments and promotions in which is a member for three years. She is dedicated to broaden the participation of women in Engineering at Rutgers. She acted as a faculty advisor for the Society of Women Engineers of the School of Engineering, she participates in program SUPER of Douglass College of Women, and she acts as an advisor to a number of women in senior and sophomore classes, many of which have pursued graduate studies.

**Publications**


**Invited Lectures**

Presentations


M.A. Orman, J. Mattick, M.G. Ierapetritou, I.P. Androulakis, and F.


**Supervised Graduate Students**

- Fani Boukouvala, Mehmet Orman, Nikisha Shah, Yijie Gao, Jinjun Zhuge, Amalia Nikolopoulou, Shuliang Zhang, Zhaojia Lin, Ruijie Zhou

**Undergraduate Students**

- Lukasz Mioduszewski
Prabhas V. Moghe  
Professor

Degrees  
B.S. (Distinction), Chemical Engineering, University of Bombay, 1988
Ph.D., Chemical Engineering (Bioengineering), U. of Minnesota, 1993

Interests  
Cell bioengineering, cell-biomaterial interactions, nanomedicine

Accomplishments  
This year, Professor Prabhas Moghe taught a graduate level course on “Biointerfacial Characterization” and a second junior level course on “Biomedical Transport Phenomena”.

Prof. Moghe continues to be actively involved in advancing research in the area of bioengineering. His grants include a NIH funded R01 award (design of synthetic counter-ligands against the accumulation of oxidized low density lipoproteins within circulation and inflammatory phenomena leading to cardiovascular disease); a National Science Foundation Nanoscale Interdisciplinary Research Team (NIRT) grant (studies of protein-based nanocarrier systems as biointerfaces for cellular motility and cell targeted bio-imaging); a COULTER foundation funded Bioengineering Research Grant (translational research, focused on development of nanolipoblocker-based intravascular devices); a New Jersey Commission on Spinal Cord Research exploratory grant (on bioactive scaffolds for neural tissue repair); and a National Science Foundation funded IGERT Program on Science and Engineering of Stem Cells. He is also one of the three Rutgers Co-PI’s on a multi-investigator NIH T32 Postdoctoral Training Program in Tissue Engineering and Implant Science.

Prof. Moghe’s research and professional activities in bioengineering continued to grow over the past year. His research was communicated in many presentations and invited talks, including talks at the Dutch Royal Academy of Sciences, Rice University, Pennsylvania State University, Rutgers University Drug Discovery and Development Day, and the City University of New York (CUNY), and talks at conferences organized by professional societies including the Society for Biomaterials, American Institute for Chemical Engineers, and the Biomedical Engineering Society.
Prof. Moghe continues to be the PI and Director of the NSF IGERT on Integrated Science and Engineering of Stem Cells, a major PhD training program at Rutgers, which has developed educational, research, and professional development activities of over 26 PhD fellows from eight different graduate programs. A second IGERT Program on Biointerfaces completed training of nearly 36 PhD fellows and will be phased off NSF funding in December 2011. He recently completed his role of the Director of the Rutgers-UMDNJ Joint Graduate Program in Biomedical Engineering at Rutgers. He is also a member of the Faculty Advisory Group of the Dean of the School of Engineering at Rutgers.

Professor Moghe has been actively developing several translational technologies that have generated intellectual property filings for patent or provisional patent applications. These include technologies for nanoscale matrix engineering, nanolipoblockers, and new window imaging for deep tissue imaging.

**Publications**


**Presentations**


**Supervised Postdoctoral Researchers**

Dr. Craig Griffith, Dr. Adam York (joint with Dr. Prud’homme at Princeton University), Dr. Dawanne Poree (with Dr. Uhrich in Chemistry and Chemical Biology)

**Graduate Students**

Aaron Carlson, Jocie Cherry, Becky Chmielowski, Kubra Kamisoglu, Joseph Kim, Daniel Lewis, Adriana Martin, Dominik Naczynski (with Dr. Charlie Roth), Sebastian Vega.

**Undergraduate Students**

Adam Freitag, Victoria Gennero, Anthony Kulesa, Kyle Minor, Muhammad Mustafa, Parth J. Patel, Rob Schulz, Jimmy Winters, Kyle Zablocki.
Fernando J. Muzzio
Professor II

Degrees
B.S., Chemical Engineering, Univ. of Mar del Plata, Argentina, 1985
Ph.D., Chemical Engineering, University of Massachusetts, 1991

Interests
Pharmaceutical Product and Process Design
Powder mixing and segregation
Continuous manufacturing
Powder processing
Catalyst manufacturing

Accomplishments
For the last 19 years, pharmaceutical product and process design has been Professor Muzzio’s main research and educational focus. His research interests comprise powder mixing, powder flow, segregation, compression, mixing and flow of liquids and suspensions, cascade impactors, tablet dissolution, and tablet coating. In the last five years, his main research focus has been the development of continuous systems for solid dose manufacturing. He is the author of over 200 peer-reviewed scientific articles, book chapters and patents, and several hundred lectures at technical conferences, companies, and universities in areas relevant to the pharmaceutical industry. He is a frequent advisor and lecturer at FDA events, and in 2010 he was appointed a voting member of the FDA committee on Pharmaceutical Sciences and clinical pharmacology.

Professor Muzzio is also the director of the National Science Foundation Engineering Research Center on Structured Organic Particulate Systems. The center, which has a life span of 10 years and a total budget in excess of $8 million per year, focuses on pharmaceutical product and process design, with special emphasis on continuous manufacturing, particle engineering, and personalized medicine. FDA and 35 companies are currently members of the center, including 11 major pharmaceutical companies and many world class technology suppliers in the equipment, instrumentation, software, and control industries. Muzzio was also the director of the recently completed National Science Foundation Integrative Graduate Education and Research training program (IGERT) in Nanopharmaceutical Engineering at Rutgers.
Publications


F. Boukouvala, A. Dubey, R. Ramachandran, M.G. Ierapetritou, and F.J.


Presentations

Eighteen papers and talks were presented at National and International conferences, and 10 additional talks and short courses were presented at federal agencies and at industrial forums, including several keynotes and invited talks at AIChE, AAPS, and FDA.

Supervised Research Professor

Kalyana Pingali

Postdoctoral Fellows

Athanas Koynov, Eric Jayjock, Atul Dubey, Yevgeny Lifschitz, Marcos Llusa

Graduate Students

William Engisch, Yijie Gao, Fani Boukouvala, Juan Osorio, Plamen Grigorov, Sara Holt, Sarang, Oka, Pallavi Pawar. Lisa Vasilenko, Aditya Vanarase
Alexander V. Neimark  
Professor II

**Degrees**  
M.S. in Mechanical Engineering, Moscow State University, Russia  
Ph.D. in Chemical Engineering, Institute of Chemical Industry, Russia  
D.Sc. in Physical Chemistry, Moscow State University, Russia

**Interests**  
Statistical Mechanics and Molecular Simulations  
Nanoscale Thermodynamics and Transport  
Computational Design and Characterization of Nanoporous Materials, Functional Adsorbents, Perm-Selective Membranes, Biomaterials

**Accomplishments**  
Prof. Neimark’s research program focuses on the computational design and characterization of nanophases and nanostructured materials, from molecular and macroscopic scales. In 2011, several multi-year projects were completed, including ARO grant Molecular Design and Characterization of Novel Nanoporous Adsorbents with Increased Chemical Removal Capacity, NIH grant subcontract Carbon Nanotube Fibers as Implantable Neural Electrodes. The work was continued on the DTRA grant “Multiscale Modeling of Permeability of Protective Polyelectrolyte Membranes to CBW Agents”, and PRL-ACS grant Adsorption and Chromatographic Separation of Chain Molecules on Nanoporous Substrates. A new grant was awarded by NSF for the collaborative GOALI program with DuPont “Multiscale Modeling of Adsorption Equilibrium and Dynamics in Polymer Chromatography”. Research was continued on DTRA grant “Multiscale Modeling of Permeability of Protective Polyelectrolyte Membranes to CBW Agents” and project Characterization of Porous Materials funded by Quantachrome Instruments. In addition, Prof. Neimark continued his work “Adsorption-induced deformation of nanoporous materials” at Ecole national Superior de Chimie de Paris funded through a Blaise Pascal International Chair Award, the highest recognition in France for a foreign scientists.

During the 2011 calendar year, Professor Neimark taught the core graduate class “Advanced Transport Phenomena II”, advised 5 graduate and 10 undergraduate students, and 2 postdocs. He co-directs Department of Education GAANN training graduate program chairing the student evaluation committee.
Nine peer-reviewed journal papers appeared in print, four in press, and one is currently under review. Prof. Neimark delivered 14 invited and keynote presentations at the international and national meeting and research organizations. In addition, he co-authored 15 other conference papers. A US patent was submitted on the discovery of “Bioactive Carbon Nanotube-Agarose Composites for Tissue Engineering”.

**Publications**


Invited Lectures


Seminar at Department of Chemistry, Lomonosov Moscow State University, Moscow, Russia, October 28, 2011


Seminar at Department of Chemistry, Peking University, Beijing, China, September 30, 2011.

Seminar at Department of Chemical Engineering, Beijing University of Chemical Technology, China, September 28, 2011.

Seminar at Department of Chemical Engineering, Tsinghua University, Beijing, China, September 27, 2011.

Invited lecture series at Nanjing University, China, September 19-23, 2011.

“Multiscale Modeling of Permeability of Protective Polyelectrolyte Membranes to CBW Agents,” Invited talk, DTRA Multifunctional Materials Workshop, Natick, MA.


Presentations


Supervised Research Professor

Aleksey Vishnyakov

Postdoctoral Fellows

Carlos Triguero, Gennady Gor

Graduate Students

Chris Rasmussen, John Landers, Ming-Tsung Lee, Rich Cimino, Nathalia Garcia

Undergraduate Students

Peter Becker, Richard Shaw, Roel Mercado, Alex Kadolka, O. Sam Luther, Remmie Yu (Summer NASA fellowship), Greg Hedon, Modupe Sonaike, Aaron Chung
**Henrik Pedersen**  
**Professor**

**Degrees**  
B.S., Chemical Engineering, University of Rochester, 1974  
M.S., Chemical Engineering, Yale University, 1976  
M.Phil., Chemical Engineering, Yale University, 1977  
Ph.D., Chemical Engineering, Yale University, 1978

**Interests**  
Biochemical engineering, immobilized enzymes, plant cell biotechnology

**Accomplishments**  
Professor Pedersen’s research uses plant cell culture techniques for propagating elite plant cultivars and for synthesis of valuable plant metabolites. Such metabolites are important fine chemicals and have long been used as pharmaceutical compounds for the treatment of a variety of diseases. These plant metabolites are also interesting for their role in plant responses to stress and for synthesis of biofuels from plant-derived triacylglycerols. Current work is focused on protocol development for cell and tissue culture methods of propagating *Lilium* cultivars.

Professor Pedersen served as the Department Chair through June 30, 2011. He is also the Education Director and a member of the Leadership Team for the NSF ERC on Structured Organic Particulate Systems. He has developed and organized educational programs involving high school students as part of the Governors School for Engineering and programs involving college undergraduates as part of a research experience for undergraduates during the summer months.

During the past year, Prof. Pedersen taught the undergraduate chemical engineering laboratory course (155:415/416) and a section of the course in computational analysis (155:307).
Rohit Ramachandran  
Assistant Professor

**Degrees**  
PhD, Chemical Engineering, Imperial College, London, 2008  
M.Eng, Chemical Engineering, National University of Singapore 2005  
B.Eng, Chemical Engineering (Honors) with a minor in Law, 2003

**Interests**  
Process systems engineering; process control; Process Simulation; Process Optimization; Mathematical Modelling; Population Balance Modelling; Experimental Studies and Validation; Pharmaceutical Engineering; Particulate and Chemical Processes; Nonlinear Identification and Control; Nonlinear Dynamics and Chaos Theory, Energy Systems Engineering

**Accomplishments**  
Professor Ramachandran’s group conducts research related to modeling, simulation, control and optimization of nonlinear distributed and lumped processes. Applications include pharmaceutical processes, petrochemical and refinery processes, and energy related processes. Tools are coupled from physics, chemistry, biology with mathematical modeling and systems engineering to develop quantitative and predictive model frameworks. Experimental validation is also an integral part of the research.

He is also a member and project leader of the NSF sponsored Engineering Research Center of Structured Organic Particulates (ERC-SOPS). His research work is currently supported by the NSF-ERC, Rutgers Research Council and BMS (Late Phase Chemical Development Group). He is a regular reviewer for numerous Tier-1 journals such as Powder Technology, Chemical Engineering Science, AIChE Journal and European Journal of Pharmaceutics and Biopharmaceutics and has also been invited to speak about his research at various pharmaceutical and consumer goods companies and professional organizations. Based on this research work, he has also been invited to speak at the upcoming New York Academy of Sciences inaugural Chemical Engineering Symposium.

Dr. Ramachandran currently supervises 6 PhD students (2 of them co-advised) and 1 postdoctoral associate (co-advised). His group also consists of 4 MS students and 3 undergraduates.
Publications


Invited Lectures


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<thead>
<tr>
<th>Postdoctoral Associates</th>
<th>Ravendra Singh</th>
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<tbody>
<tr>
<td>Supervised Graduate Students</td>
<td>Anwesha Chaudhury, Maitraye Sen, Ruijie Zhou, Dana Barrasso Umar Khokkar, Charles Clercuzio, Anuj Prakash, Divya Mohan, Joyce John, Koushik Anush</td>
</tr>
<tr>
<td>Undergraduate Students</td>
<td>Alex Niziolek, Avi Kapadia, Courtney Stanton</td>
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Charles Roth
Associate Professor

Degrees
B.S.E., Chemical Engineering, University of Pennsylvania, 1989
Ph.D., Chemical Engineering, University of Delaware, 1994

Interests
Nanobioengineering
Nucleic acid delivery for gene silencing
Engineering approaches to cancer

Accomplishments
Professor Charles Roth leads an active research group working primarily in nanobioengineering. The Roth group develops a quantitative understanding of and engineering solutions to the problem of delivering nanoparticles carrying nucleic acids across physiological, tissue, cellular and intracellular barriers. One application of this work, supported by the National Institutes of Health, is to silencing of oncogenes in tumors. Professor Roth also has funding from the Department of Defense to apply his technologies to the control of stem cell fate for prevention of heterotopic ossification following blast and related traumatic injuries.

Prof. Roth taught the senior course in “Chemical Engineering Kinetics”. He taught a graduate elective in “Pharmaceutical Organic Nanotechnology” that covers both fundamental and applied aspects of drug delivery technology. In addition, he taught a freshman seminar in the area of “Nanotechnology for Cancer” to engage our incoming students intellectually at an early stage. He supervised eight undergraduates in “Special Problems” and/or as summer research fellows. Among these, Molly Carroll received two research awards from the Aresty Foundation, Maya Saltzman was named an Aresty Summer Science Scholar and Izmarie Poventud-Fuentes (co-supervised with Professor Moghe) received a best poster award at this year’s Annual Biomedical Research Conference for Minority Students.

Prof. Roth is the Director of an NSF-funded Research Experience for Undergraduates (REU) program in the area of Cellular Bioengineering. Over the past two years, this program has brought 20 students to Rutgers for a summer of mentored research in cutting-edge laboratories combined with professional development and social activities. The vast majority of
underrepresented minority groups, are first generation to college and/or participants come from hail from predominantly undergraduate research institutions that do not have significant research opportunities of their own. In addition to this major leadership role, Prof. Roth is active in departmental service, serving for the past seven years on the Faculty Search Committee and leading a new undergraduate student group called the Rutgers University Bioengineering Society, which consists of chemical engineers, biomedical engineers and others interested in learning about opportunities and challenges facing the field of bioengineering, broadly defined. Beyond Rutgers, Prof. Roth was appointed this year to serve as a “permanent member” (6 year term) of the Gene and Drug Delivery study section of the NIH.

**Publications**


**Presentations**

M. McCoy, L.M. Nusblat, and C.M. Roth, “Combined Effects of Carmustine and STAT3 SiRNA Silencing in Glioblastoma Spheroids,” Annual Biomedical Research Conference for Minority Students, St. Louis, MO, November 2011.

I. Poventud-Fuentes, M. Zevon, D.J. Naczinski, C.M. Roth, and P.V. Moghe, “Effects of Albumin Nanoparticles’ Physical Characteristics on Tumor Penetration,” Annual Biomedical Research Conference for Minority Students, St. Louis, MO, November 2011.

L. Peddada, A. Joy, M. Costache, D. Devore, O. Garbuzenko, T. Minko, and C.M. Roth, “Multifunctional Graft Copolymers Aid Liposomal


Postdoctoral Associates

Swati Mishra

Supervised Graduate Students

Carolyn Waite (Ph.D. 2011), Lavanya Peddada (Ph.D. 2011), Dominik Naczynski (with Prof. P. Moghe), Aina Adrianarijaona, Leora Nusblat, Margot Zevon (with Prof. P. Moghe), Juan Lagos (part-time)

Undergraduate Students

Molly Carroll, Michael McCoy, Izmarie Poventud-Fuentes (with Prof. P. Moghe), Maya Saltzman, Neil Raju, Kyle Minor (with Prof. P. Moghe), Meagan O’Kane, Brittany Gladney
Jerry I. Scheinbeim
Professor II

Degrees
B.S., Physics, Polytechnic Institute of Brooklyn, 1968
M.S., Physics, University of Pittsburgh, 1969
Ph.D., X-ray Crystallography and Chemical Physics,
University of Pittsburgh, 1975

Interests
Structure-electrical properties relationships in polymers
Ferroelectric, piezoelectric, pyroelectric, dielectric, and electrostrictive
properties of polymers, biocompatible piezoelectric substrates for cell
plasticity and growth, electro-deposition of nano particles.

Accomplishments
The major focus of the Polymer Electroprocessing Laboratory is the study
of the ferroelectric, piezoelectric, pyroelectric, electrostrictive, and
dielectric properties of polymers. Research in this laboratory is directed
towards the discovery and/or creation of controlled-property polymeric
materials for use as sensors, actuators, and transducers.

We have shown that the use of a biocompatible piezoelectric polymer
substrate to provide time varying electric fields significantly increased
neurite outgrowth and arborization of growing rat spinal cord neurons.
This work was funded by the NJ Commision on Spinal Cord Research. We
developed and are testing a device for the electro-deposition of
pharmaceutical nano particles on a biodegradable polymer substrate. This
work was internally (gift) funded.

Prof. Scheinbeim served as a member of the Faculty Council.

Publications
N. Royo, M. Winninger, J. Scheinbeim, B. Firestein, and W. Craelius
“Piezoelectric Substrates Promote Neurite Growth in Rat Spinal Cord

Patents
Patent Disclosure, Piezoelectric Substrate Materials for Cellular Growth,
2011.

Directed Visiting Professor
Prof. Nadarajah Vasanthan
<table>
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<tr>
<th>Supervised Graduate Students</th>
<th>Sheng Chan</th>
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<tr>
<td>Undergraduate Students</td>
<td>Miles Christian</td>
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Nina C. Shapley  
**Associate Professor and Graduate Program Director**

**Degrees**  
A.B., Physics, Harvard University, 1993.  
Ph.D., Chemical Engineering, Massachusetts Institute of Technology, 2000

**Interests**  
Multiphase flow in complex geometries  
Imaging, particularly magnetic resonance imaging (MRI)  
Microencapsulation and nanoencapsulation  
Colloidal interactions of biopolymer gel particles  
Mass transfer in multiscale structured polymer particles

**Accomplishments**  
Professor Nina Shapley pursues research interests involving the areas of multiphase flow, imaging, and colloid science. Her long term research goal is to gain fundamental insight into concentrated suspension flows and structured particle design and to channel that understanding into new ways of processing and utilizing advanced, “green” particulate materials.

Prof. Shapley's research group currently consists of three Ph.D. students and six undergraduate researchers. During the past three years at Rutgers and during her previous position as a junior faculty member at Columbia University, Prof. Shapley has published multiple peer reviewed papers in high quality journals, including Physics of Fluids, Journal of Rheology, Analytical Chemistry, Journal of Magnetic Resonance, and Biotechnology Progress, and her group regularly contributes several presentations to the AIChE Annual meeting.

Prof. Shapley’s research focuses on two main directions: (i) understanding complex geometry flows of concentrated suspensions through quantitative imaging measurements; and (ii) development of “green” particle tools and technologies. Current projects include: the development of novel biosorbents for water purification that consist of biopolymer gel nanoparticles and microparticles; determining the level of ultraviolet (UV) protection of sensitive pigment molecules co-encapsulated in a structured polymer particle; coating microparticles with nanoparticles in solution for controlled handling of pharmaceutical particles; and magnetic resonance imaging (MRI) measurements of
particle separation in flows of concentrated bimodal suspensions (two particle sizes). One recent accomplishment that Prof. Shapley is pleased to share is the receipt of an award from the USDA Agriculture and Food Research Initiative (AFRI) program together with collaborators Prof. Karl Matthews in the Department of Food Science and Prof. Anubhav Tripathi at Brown University. The three-year project is entitled, "Developing 'Green Nanotechnology' for Eliminating Foodborne Pathogens." The goal of the project is to develop ultra-potent antimicrobial nanoparticles formed from edible natural materials and a corresponding nanoparticle treatment procedure for minimally processed foods such as fresh and fresh-cut produce. If used in conjunction with conventional antimicrobial treatments, the new method has the potential to reduce the concentrations of chemical preservatives and energy intensity required for pathogen elimination from current levels.

Over the past year, Prof. Shapley taught one core undergraduate course, “Transport Phenomena II: Mass and Heat Transfer,” and one graduate course, “Advanced Transport Phenomena I: Fluid Mechanics.”

In February, 2011, Prof. Shapley took on the role of Graduate Program Director for Chemical and Biochemical Engineering. She continues to serve as the advisor for the OXE honor society. She has actively participated in outreach efforts on campus, including TARGET and RISE, aimed at recruiting high school girls and undergraduate women to scientific fields. Outside Rutgers University, Prof. Shapley has served as chair of technical sessions at national meetings of the AIChE and the Society of Rheology.

**Publications**


**Invited Lecture**

Presentations


Supervised Graduate Students

Kapil Deshpande, Kristin Steeley, Kun Yu

Undergraduate Students

Jackie Ho, Jonathan Liu, Samie Leigh, Louis Ruggeri, Adam Cham, David Park, Danielle Mazza (Ramapo College)
Stavroula Sofou
Associate Professor

Degrees
B.S., Chemical Engineering, National Technical Univ., Greece, 1994
Ph.D., Chemical Engineering, Columbia University, NY, NY, 2001

Interests
Heterogeneous biomembranes
Environmentally responsive lipid vesicles
Transport limitations in liposomal chemotherapy to solid tumors
Alpha-particle therapy of cancer
Integrated strategies for targeted liposome-based cancer chemotherapy and internal radiotherapy of cancer

Accomplishments
Professor Stavroula Sofou runs a successful research program with the focus on the fundamental analysis of self-assembling heterogeneous lipid membranes, engineering of devices and strategies based on the collective properties of these materials, and translation and optimization of these materials in the form of nanoparticles as carriers of diagnostics and therapeutics for medical applications.

Prof. Sofou's research group currently consists of two Ph.D. students, and two undergraduate assistants. During the last two years, Prof. Sofou has published four peer reviewed papers and three more are currently in review in top quality journals. She has also published an invited review and she co-edited a theme issue for the journal NanoLife. She has also been invited to contribute to high quality books, such as the Drug Delivery in Oncology. From Basic Research to Cancer Therapy, edited by Drs. F. Kratz, P. Senter and H. Steinragen that is published by Wiley-VCH and appeared in October of the current year.

The most prestigious current achievement of Prof. Sofou is the Research Scholar Grant from the American Cancer Society on targeted alpha-particle radiotherapy. This is the first grant application Prof. Sofou submitted after joining Rutgers. Prof. Sofou’s research on fundamental studies on heterogeneous lipid bilayers is supported by a SEED grant from the NSF-funded MRSEC program at NYU where she was a faculty member before joining Rutgers. Prof. Sofou’s research on environ-
mentally responsive lipid vesicles and their use as drug delivery carriers to advanced breast cancer is supported by a Career Catalyst Award from Susan G. Komen foundation for Breast Cancer Research.

Prof. Sofou is the recipient of the Busch Memorial Fund Award from Rutgers University and of the A. Walter Tyson Associate Professorship Award from Rutgers University for the year 2011.

Prof. Sofou has also established successful collaborations with physicians, medical physicists, and radiochemists at Memorial Sloan-Kettering Cancer Center, at Cornell Weill Medical College, at Johns Hopkins Medical Institutes and at the European Institute for Transuranium Elements in Germany. Her interdisciplinary research on alpha-particle therapy is the hub of all these collaborations. Prof Sofou’s research on developing lipid-based approaches for gene therapy aiming to mitigate cutaneous radiation injury is another example of a fruitful collaboration with physicians at the New York University Medical Center.

Prof. Sofou has also fostered strong collaborations with other faculty members within and outside the university to tackle interdisciplinary problems. She collaborates with Prof. Yarmush and the Center for Innovative Ventures of Emerging Technologies (CIVET) to assist in translating her work to the industrial and clinical arenas; with Prof. Michniak to study the biomembrane activity of nanoparticles used successfully for delivery applications to the skin; and with Prof. Hall at North Carolina State University to study dual-fusogenic lipid-based nanocarriers for targeted antivascular chemotherapy.

Prof. Sofou taught one core undergraduate level course, “Transport Phenomena I,” and one elective undergraduate course, “Engineering Principles of Drug Delivery” since she joined Rutgers in January 2011. She also taught/ advised one session in the course: Topics in Advanced Biotechnology.

Prof. Sofou actively participates in the Senior Design course in which she is supervising three undergraduate students. She also advises an Honor’s College student who is conducting independent research. She also participated in the REU (Research Experiences for Undergraduates) program for which she advised one undergraduate female student.

Prof. Sofou is active in several committees and initiatives in the Department and the School of Engineering including her role as member of the Committee for Graduate Admissions, as undergraduate advisor in BME, and as member of CIVET.
Outside Rutgers University, Prof. Sofou has served as co-chair of technical sessions at the national meeting of the American Institute of Chemical Engineers (AIChE) and the Biomedical Engineering Society (BMES) during the last couple of years.

Prof. Sofou serves as member of the editorial boards of the journals Drug Delivery and NanoLife.

**Publications**


**Invited Lectures**

“Lipid-based heterogeneities controlled by pH: basic studies and potential applications in liposome-based chemotherapy” at the Max-Plank Institute for the Physics of Complex Systems in Dresden, Germany (July 15, 2011).

“Lipid-based heterogeneities controlled by pH: basic studies and potential applications in liposome-based chemotherapy” at the Graduate Student Conference at Princeton University, Princeton, NJ (October 28, 2011).

“Solid Domains on Fluid Lipid Vesicles Induced by pH” at the TMS annual conference in San Diego, CA (February 27 - March 3, 2011).

“Heterogeneous Lipid Bilayers Controlled by pH” at the DFG-NSF Research Conference on *Bioinspired Design and Engineering of Novel*
Presentations

A. Bandekar and S. Sofou, “Triggered Binding Activity of Anti-HER2/Neu Lipid Vesicles Encapsulating Doxorubicin Enhances Tumor Control In Vivo While Preserving The Potential For Low Toxicities” at the AICHE annual meeting 2011, October 18-21, 2011, MN.

A. Bandekar and S. Sofou, “Floret-Shaped Solid Domains On Giant Fluid Lipid Vesicles Induced by pH” at the AICHE annual meeting 2011, October 18-21, 2011, MN.

A. Bandekar and S. Sofou, “Triggered Targeting of Liposomal Chemotherapy In Vivo Controls Tumor Growth and Potential Toxicities” at the BMES annual meeting 2011, October 14, 2011, New Haven, CT.

E. Mamasheva, C. O’Donnell, A. Bandekar, and S. Sofou, “Heterogeneous liposome membranes with pH-triggered permeability enhance the in vitro antitumor activity of folate-receptor targeted liposomal doxorubicin” at the BMES annual meeting 2011, October 14, 2011, New Haven, CT.


Supervised Graduate Students

Ana Gomez, Amey Bandekar

Undergraduate Students

Madaser Saleem, Michelle Sempkowski


“Antivascular alpha-particle therapy by targeted liposomes loaded with Ac-225” at the 7th Targeted Alpha-particle Therapies Symposium, July 18-19, Berlin, Germany
M. Silvina Tomassone
Associate Professor

Degrees
M.S., Physics, University of Buenos Aires, Argentina, 1992.
M.S., Physics, Northeastern University, 1995.
Ph.D., Physics, Northeastern University, 1998.

Interests
Synthesis of Nanoparticulate Suspensions
Granular Materials
Crystallization of Pharmaceuticals

Accomplishments
Professor Tomassone has over twelve years of experience in modeling of particulate and molecular systems. She continues to work in modeling and since joining Rutgers in 2001, she has been working in experimental nanoparticle synthesis and production, crystallization of pharmaceuticals and the dynamics of granular materials. These research efforts, from June 2010 until December 2011, were reflected in thirteen papers that were published or in press and 5 submitted papers that are currently under review. Professor Tomassone’s group consists of 9 members in total, 3 Ph.D. students, 3 post doctorate associates, and 3 undergraduate students.

To date, Dr. Tomassone has authored more than 60 publications, 28 invited talks and more than 100 conference presentations. In 2011 she has been an invited speaker at four prestigious schools: City College of New York; Tennessee Tech University; University of Delaware and Columbia University. She gave invited seminars at the Department of Chemical Engineering in these schools.

Her research is supported by grants from NSF, NIH and industrial funds. Her research and scientific accomplishments were recognized through several scientific awards including the NSF-NIH IGERT Award in Nanopharmaceutical Engineering and Science and the Board of Trustees Research Award for Scholarly Excellence from Rutgers University.

During 2011, Prof. Tomassone received an award for the study of freeze-drying of pharmaceutical powders for $100,000 from Aerosol Therapeutics. This award will be used to develop and characterize a new methodology to manufacture freeze-dried powders with the aim of reducing process duration time and material collection efficiency. She
also received an award for $37,000 from the Consortium Manufacturing at Rutgers for the study of Impregnation of Alumina Powders. She is actively involved in the Engineering Research Center at Rutgers from which she also receives funding in excess of $120,000 per year. Since 2001, her work has been funded by federal, state, and industrial research funding exceeding $7MM.

During the past three years Dr. Tomassone has served as the Undergraduate director of the Department and she will continue in this administrative service capacity until July 2012. She has also served for 5 consecutive years as the co-Director of the IGERT Program in Nanopharmaceutical Engineering and Science at Rutgers. From its inception in 2006 this program, awarded by the National Science Foundation with $3.4MM, has funded 30 Ph. D. students, until its culmination in July 2011.

During the past year Dr. Tomassone taught two core courses at the junior level: “Transport Phenomena I” and "Thermodynamics for Chemical Engineers", from which she received two consecutive awards in “Excellence in Teaching Awards 2010 and 2011” from the Engineering Student Council Center at the Department of Chemical and Biochemical Engineering.

During the year, two of Dr. Tomassone’s doctoral students got their Ph.D. One of them got a position at BASF where he will be working starting in February 2012, the second student is currently working as a post-doctorate associate in her own research group.

**Publications**


F.S. Romanski, E. Jayjock, F.J. Muzzio, and M.S. Tomassone “Important Factors in the Size Reduction of Polymer-Stabilized Drug Particle


**Invited lectures**

“Molecular Simulation Studies on the Rheological Properties of Silica Nanoparticles Embedded in a Polyethylene Melt,” City College of New York, Department of Chemical Engineering, March 27th, 2011.

“Rheology and Dispersion of Nanoparticles Embedded in Polymer Melts,” Tennessee Tech University, Department of Chemical Engineering, November 15th, 2011
“Multiscale Simulations on the Rheology and Dispersion of Silica Nanoparticles Embedded in Polymers and Surfactants,” University of Delaware, Department of Chemical Engineering, October 28th, 2011

“Polymer Nanocomposites: Dispersion and Rheology,” Columbia University, Department of Chemical Engineering, December 5th, 2011.

**Presentations**


Y. Shen and M.S. Tomassone, “Molecular Simulation Studies On the Rheological Properties of Silica Nanoparticles Embedded In a Polyethylene Melt,” AICHE Annual Meeting, Minneapolis, Minnesota, October 2011.


**Supervised Post Doctoral Associates**

Francis S. Romanski, Wusheng Zhu, Yangyang Shen

**Graduate Students**

Jennifer Winkler, Mike Tomasini, Kurt Smith.

**Undergraduate Students**

Emmanuel Scoullos, Ramon Pena, Matthew Rodis
Departmental Staff

Debora Moon
Department Administrator

Lynn DeCaprio
Administrative Assistant
Undergraduate Program

Kirk Tarabokia
Systems Administrator

Engineering Research Center for Structured Organic Particulate Systems Staff

Eric Erenrich
Associate Director
Industrial Relations

Charanjeet Kaur
Associate Director
Administration and Finance

Aisha Lawrey
Associate Director
Education and Outreach

Aruna Chadda
Business Specialist

Doug Hausner
Manager, Intellectual
Property and Industry Partnership
The Undergraduate Program
Degrees, Honors, Awards, Scholarships, and Activities

Degrees  The Undergraduate Program of the Department graduated sixty-three students with the degree of Bachelor of Science in Chemical Engineering. Among the sixty-three graduates, fifty-five pursued the Chemical Engineering option and eight chose the Biochemical Engineering program. Four of these graduates were designated James J. Slade Scholars.

A profile of the B.S. degrees awarded each year since 1964, the year of the Department’s first graduating class, is presented in Figure 1, along with the number of B.S. degrees in Chemical Engineering awarded by all Departments of Chemical Engineering in the United States. It is evident that the enrollment in this Department has followed the national trends. The cumulative number of B.S. degrees granted since 1964 now totals 2132.

The quality of the students graduating with the B.S. degree in the Department in 2011 again remains substantially high. Of the sixty-three graduates, thirty-three (56%) received honors distinction:

*Highest Honors*  Tiffany Chiang, Richard Cimino, Keith Croly, Christopher Dobranzki, Daniel Fitzpatrick, Danielle Gal, Jackie Ho, Michael Infante, Anchal Jain (Slade Scholar), Brett Kuestermeyer, Roel Mercado, Nhan Pham, Sharon Shiechkorn, Chelsea Stanton, Pratik Suratia

*High Honors*  Victoria Carey, Michael Edley, Brittany Gladney (Slade Scholar), Steve Koshlyak, Brian Kwan
**Honors**  
Emmanuel Adachi, Paul Berger, Alicia Boyd, Michael Coyle, Sachin Desai (Slade Scholar), Zhaoyi Hu, Alexander Kadolka, Melissa Lash (Slade Scholar), Jasmine Richards, Ritesh Shah, Matthew Shatynski, Shikai Sun, Jon Tarczewski

**Awards**  
Of special note at this year’s graduation, Nahn Pham received the Outstanding Engineering Scholar Award, which is awarded each year to the graduating seniors in Engineering who have amassed the highest cumulative grade point average (G.P.A.). Nahn graduated with a perfect 4.00/4.00 G.P.A.

Twelve students of the Department were initiated into the Beta Sigma Chapter (at Rutgers) of the National Omega Chi Epsilon Honor Society for Chemical Engineers. Prof. Nina Shapley is the Faculty Advisor for the Chapter.

Four seniors attended the National AIChE Annual Meeting in Minneapolis, MN, in November 2011. One student received a 1st place award in the student poster competition. The following students: David Sejin Park (senior), Gregory Heden (senior) and Emmanuel Scoullos (junior) in the Department of Chemical and Biochemical Engineering, participated in the Annual College Bowl sponsored by the New Jersey Section of the American Institute of Chemical Engineers. Other universities competing in the College Bowl were NJIT, Princeton, and Seton Hall. The Rutgers team took the first place in the competition.

The Student Awards Committee of the New Jersey Section of the American Institute of Chemical Engineers at its annual awards dinner, on March 22, 2011 selected the following students for the 2011 Student Awards:

- Joseph Vella: Merit Award, Junior Class
- Nhan Pham: Merit Award, Senior Class
- Anchal Jain: Science and Research Award
- Sharon Shliechkorn: Most Deserving Award

**Scholarships**  
The following students have been awarded the 2010-11 Scholarships:

- Michael Edley: Dittman/Lebo Scholarship
- Alexander Niziolek and Courtney Stanton: Merck E&T Fellowship
- Courtney Stanton and Remie Yu: Hess Scholarship
- John D. Santiago: School of Engineering Scholarship

The following students received Scholarships for the year 2011-12:

- Emanuel Scoullos: Dittman/Lebo Scholarship
- Courtney Stanton: Schlanger Scholarship
- Amon Pena, Deepal Shah, and Joseph Threlfall: Robert Gilmore/ExxonMobil Scholarship
Prof. Silvina Tomassone was the Faculty Advisor to the AIChE Student Chapter. The officers of the Chapter for the academic year 2010-2011 are listed below:

<table>
<thead>
<tr>
<th>Officers</th>
<th>Acad. Year 2010-2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>President</td>
<td>Pratik Suratia</td>
</tr>
<tr>
<td>Internal Vice President</td>
<td>Anchal Jain</td>
</tr>
<tr>
<td>External Vice President</td>
<td>Melissa Lash</td>
</tr>
<tr>
<td>Secretary</td>
<td>Tiffany Chiang</td>
</tr>
<tr>
<td>Treasurer</td>
<td>Kevin Miranda</td>
</tr>
<tr>
<td>ChemE Car Liaison</td>
<td>Kevin Miranda</td>
</tr>
<tr>
<td>PR&amp;Webmaster</td>
<td>Kimberley Ulaky</td>
</tr>
<tr>
<td>EGC Representative</td>
<td>Gregory Heden</td>
</tr>
</tbody>
</table>

Several events took place during the Fall of 2010, organized by the AIChE Student Chapter:

- **“The Drexel Professor Event”**: A professor from Drexel University visited Rutgers to give an information session about graduate school and other options after graduation. During this event a number of students were also recruited to participate in Drexel University’s Masters Program.

- **In September 2010 the AIChE Student Chapter organized the “Involvement Fair” in Busch Campus.** This was an open forum for all students to learn about the various organizations at Rutgers. Up to 700 students participated in this important, with significant attendance of freshmen students.

- **Volunteer tutoring session co-sponsoring with SHE**: In October 2010, in an effort to help students do well in classes, 40 students (the upperclassmen) were involved in helping the underclassmen on a volunteer basis.

- **Rensselaer Polytechnic Institute (RPI) International Scholars Program (ISP) info session**: In November 2010, an RPI representative spoke about the ISP program in efforts to recruit students to perform post-graduate studies. The International Scholars Program is a 10-week global learning experience, where students are immersed in the culture, day-to-day living, and business environments of Europe and Asia. Thirty students attended the event.

- **A trip to a brewery, sponsored by the Omega Chi Epsilon** was scheduled for November 2011. The senior students had a tour of the “Yards Brewery” in Philadelphia. Seventy students attended.

- **“Graduate school vs. Industry info session”**: In March 2011, an open forum to all students took place to hold discussions about post-graduate studies and industry. Representatives from industry and graduate school spoke about their experiences. A large number of students attended this event.
• “Merck Info Session,” in November 2010 on the Busch Campus. Thirty students attended the Merck Info Session event in which representatives from Merck, led by Dr. Erik Dienemann, talked about the company in efforts to recruit students for full-time positions as well as internship opportunities.

• At the end of the Fall 2011 term, our Student Chapter of Omega Chi Epsilon sponsored a department-wide ice cream and social event.

Noteworthy, too, was the strong participation of the Student Chapters of AIChE and Omega Chi Epsilon in the School of Engineering’s Annual Spring Open House.

At the end of the Fall 2011 term, our Student Chapter of Omega Chi Epsilon sponsored a department-wide ice cream and social event.

Prof. Henrik Pedersen was the Faculty Advisor to the ISPE Student Chapter. The chapter organized two seminars with industrial speakers, and a trip to the InterPhex Show in New York City in the Spring semester.

The E-Board for ISPE for 2010-2011 is listed below:
President: Sachin Desai
Vice President: Melissa Lash
Treasurer: Meaghan O’Kane
Secretary: Sameera Namazi
EGC Representative: Morgan George
The Graduate Program
Graduate Degrees and Student Quality

In the 2011 calendar year, the Graduate Program of Chemical and Biochemical Engineering graduated two students with the M.S. degree, two students with the M.E. in Pharmaceutical Engineering and Science degree, and nine students with the Ph.D. degree. A listing of the graduate degrees awarded, including employer, thesis title, and thesis advisor, is provided in Table 1 (p. 80). The historical profiles (5-year averages) for graduate degrees awarded since 1981 are shown in Figure 2. The number of Ph.D. degrees granted per year has generally ranged between six and ten for the last few years.

![Figure 2: Degrees Awarded by the Graduate Program (5-year averages)](image)

Student quality in the Graduate Program in Chemical and Biochemical Engineering is evidenced by many factors, such as the average scores on the Graduate Record Examination (GRE) of the entering students, the number of fellowships awarded, student presentations and papers, and post-graduate job placement. The average GRE score for the incoming class in the fall of 2011 was at 1223 (see Figure 3).

During the Fall 2011 semester, there were 93 students enrolled in the Graduate Program (52 were working towards the doctoral degree and 41 towards the Master’s degree). Of the Ph.D. students, 42 were full-time students and 10 were part-time. Of the 42 full-time students, the Biotechnology Program supported one, and six had SOE fellowships, one had the Rutgers University Bevier fellowship, one had the Kris Venkat fellowship, four were GAANN fellows, three were IGERT fellows, one was a NSF Diversity fellow, four were supported as Teaching Assistants, and the rest as Graduate Assistants supported by research grants. Of the Master’s students, 27 were full-time students (22 M.S.; 5 M.E.) and 14 were part-time (10 M.S.; 4 M.E.). Two of the M.S. students were...
enrolled in the new combined 5-year B.S./M.S. program for Rutgers undergraduates. Several additional Master’s students participated in Graduate Program courses through the new M.B.S. program (Master of Business and Science) directed by Prof. Deborah Silver, with a concentration in Chemical Engineering.

The quality of student research is reflected in the number of presentations at national meetings: At the 2011 Annual Meeting of the American Institute of Chemical Engineers, held in Minneapolis, MN in October, the faculty and graduate students of this Department had over 60 papers and poster presentations.

Enrollment by degree level is shown in Figure 4. The total number of students in the growing M.S. program is 41, and the number in the Ph.D. program has been maintained close to the present level of 52 students. A number of students in the part-time M.S. program are on leave each semester and may continue their studies in the future according to their job workload commitments. There are also currently 12 non-degree students taking classes in Chemical and Biochemical Engineering. Most of these students work in local industry.

In March of this year, 12 applicants from the region were invited to campus for a day of orientation, faculty and student meetings, and evening dinner and entertainment. Five new students who were participants in this event joined Rutgers. The stipend levels for supporting new students have continued to rise to match levels awarded by peer institutions from around the country. The School of Engineering and the
Department have made improved visibility a top priority. Continued success in recruiting excellent new students to the Program can be expected to rely heavily on bringing students onto the campus during the early spring, and being able to offer competitive financial packages and compelling research narratives as early as possible. Recent recruiting efforts have also focused on attracting outstanding international Ph.D. and M.S. applicants, with a substantially successful strategy of early offers and frequent communication. With multiple new faculty members joining the Department, improved recruiting materials such as updated brochures and an enhanced departmental website are the next goals regarding graduate admissions.

![Figure 4: Enrollment in the Graduate Program](image)

**Biotechnology Training Program**

The Graduate Program participates in a NIH-sponsored Ph.D. training program in Biotechnology. Prof. Yarmush serves as the Director of the Biotechnology Training Program. This program, which provides graduate student stipend support in targeted areas of research and training, is multi-disciplinary and involves not only graduate students from Chemical and Biochemical Engineering, but also from chemistry, molecular biology, microbiology, pharmacy, cell and developmental biology, as well as the University of Medicine and Dentistry graduate program in molecular biosciences. The program supports approximately 9 students per year. The University and industry provide some additional matching fellowships to use as stipend support. In total, 30 graduate students receive support from these programs, including 4 current students from Chemical and Biochemical Engineering at some point during their studies.
Master of Engineering in Pharmaceutical Engineering and Science

A new professional Master’s degree program recently founded within the Graduate Program is the Master of Engineering (M.E.) in Pharmaceutical Engineering and Science. Prof. Glasser and Prof. Muzzio direct the program. Students have already graduated from the new degree program, and nine students (five full-time and four part-time) were enrolled in the Fall 2011 semester.
### Table 1. GRADUATE DEGREE RECIPIENTS - CALENDAR YEAR 2011

#### Ph.D. Degrees

<table>
<thead>
<tr>
<th>Student/Position</th>
<th>Degree</th>
<th>Thesis Title</th>
<th>Advisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zhen Hou Postdoctoral Associate, University of Delaware</td>
<td>Ph.D.</td>
<td>Software Tools for Molecule-Based Kinetic Modeling of Complex Systems</td>
<td>Klein</td>
</tr>
<tr>
<td>Eric M. Jayjock Postdoctoral Associate, Rutgers University</td>
<td>Ph.D.</td>
<td>Advanced Data Inversion Applied to Cascade Impactor Data</td>
<td>Muzzio</td>
</tr>
<tr>
<td>Matthew J. Metzger Postdoctoral Associate, Rutgers University and University of the Witwatersrand</td>
<td>Ph.D.</td>
<td>Numerical and Experimental Analysis of Breakage in a Mill Using the Attainable Region Approach</td>
<td>Glasser</td>
</tr>
<tr>
<td>Mehmet A. Orman Postdoctoral Associate, Princeton University</td>
<td>Ph.D.</td>
<td>Bioinformatics Analysis of Control Mechanisms of Burn and Sepsis Induced Inflammatory Response</td>
<td>Androulakis</td>
</tr>
<tr>
<td>Ayse Meric Ovacik Postdoctoral Associate, SUNY Buffalo</td>
<td>Ph.D.</td>
<td>Pathway Modeling: From Gene Expression to Pathway Dynamics</td>
<td>Androulakis</td>
</tr>
<tr>
<td>Francis S. Romanski BASF</td>
<td>Ph.D.</td>
<td>The Production and Stabilization of Pharmaceutical Nanosuspensions</td>
<td>Tomassone</td>
</tr>
<tr>
<td>Alisa Vasilenko L’Oreal</td>
<td>Ph.D.</td>
<td>Rheological Properties of Granular Materials - Critical Parameters and Mixing Rules</td>
<td>Muzzio</td>
</tr>
<tr>
<td>Carolyn L. Waite Defense Intelligence Agency</td>
<td>Ph.D.</td>
<td>Engineering Tumor-Targeted Poly(amidoamine) (PAMAM) Dendrimers for Improved Penetration and Cellular Delivery of Short-Interfering RNA (siRNA) through Solid Tumors</td>
<td>Roth</td>
</tr>
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</table>

#### M.S. Non-thesis Option

<table>
<thead>
<tr>
<th>Student/Position</th>
<th>Degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shannon P. High, Merck Shou-Hung Wang</td>
<td>M.E. in Pharmaceutical Engineering and Science</td>
</tr>
</tbody>
</table>
Seminars
# Department Seminars - Spring 2011

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Title</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Lea Hildebrandt</td>
<td>Atmospheric Organic Nanoparticles: Importance, Challenges and Progress</td>
<td>January 26, 2011</td>
</tr>
<tr>
<td>Carnegie Mellon University</td>
<td></td>
<td></td>
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<tr>
<td>Pittsburgh, PA</td>
<td></td>
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<tr>
<td>Dr. Kevin Sivula</td>
<td>Bottom-up Control of Materials and Morphology for Solar Energy Conversion</td>
<td>February 9, 2011</td>
</tr>
<tr>
<td>Swiss Federal Institute of</td>
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<tr>
<td>Technology</td>
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</tr>
<tr>
<td>Dr. Celeste Nelson</td>
<td>Morphogenesis of Engineering Epithelial Trees</td>
<td>April 4, 2011</td>
</tr>
<tr>
<td>Princeton University</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Princeton, NJ</td>
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</tr>
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</table>

# Department Seminars - Fall 2011

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Title</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Sanar Kumar</td>
<td>Tailoring Polymer Nanocomposite Properties by Nanoparticle Assembly</td>
<td>November 16, 2011</td>
</tr>
<tr>
<td>Columbia University</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New York, NY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr. Mark Brynildsen</td>
<td>Combating antibiotic failure: Engineering approaches to develop next generation antimicrobials</td>
<td>December 7, 2011</td>
</tr>
<tr>
<td>Princeton University</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Princeton, NJ</td>
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</table>
Projects Funded
<table>
<thead>
<tr>
<th>Award Amount</th>
<th>Principal Investigator/Sponsor/Title</th>
<th>Start Date/End Date</th>
</tr>
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<tbody>
<tr>
<td>$316,117</td>
<td>Ioannis Androulakis</td>
<td>01-Sep-2007/30-Nov-2012</td>
</tr>
<tr>
<td></td>
<td>NSF CBET 0730582</td>
<td></td>
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<tr>
<td></td>
<td>&quot;Reactive Flow Simulation Using an Adaptive Chemistry Framework&quot;</td>
<td></td>
</tr>
<tr>
<td>$141,566</td>
<td>Ioannis Androulakis</td>
<td>01-Sep-2008/30-Nov-2012</td>
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<td>Masanori Hara</td>
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<td>ONR-N00014-10-1-0440-Modeling Complexities &quot;Modeling Complexities in Biofuel Combustion&quot;</td>
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<td>Prabhas Moghe</td>
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$58,896  **Fernando Muzzio**  
NIPTE, INC. - DEVELOPMENT OF QUALITY BY  
"Development of Quality by Design (qbd) Guidance Elements on Design Space Specifications Across Scale with Stability Considerations"  
18-Sep-2008 31-Dec-2011

$270,000  **Fernando Muzzio**  
WARNER-LAMBERT  
"Optimization and Control of Microdispensing of Liquids and Suspensions into Hard Capsules"  
01-May-2009 31-Jan-2011

$26,963  **Fernando Muzzio**  
HALDOR TOPSOE A/S  
Intergration of Haldor Components into a System for Powder Flow GDR Characterization Technique  
01-Jun-2009 28-Feb-2014

$98,261  **Fernando Muzzio**  
HALDOR TOPSOE A/S - Determination of Opt  
"Determination of Optimum Milling Parameters for Magnesia Extrudate"  
01-Jan-2010 28-Feb-2014

$70,714  **Fernando Muzzio**  
HALDOR TAPSOE A/S - Determination of Mix  
"Determination of Mixing and Lubrication Parameters for Milled Catalyst Extrudate"  
01-Jan-2010 28-Feb-2014

$69,924  **Fernando Muzzio**  
HALDOR TAPSOE A/S - Effects of Feed Fram  
"Effects of Feed Frame Parameters on the PSD and Flow Properties of Milled Magnesia Blends"  
01-Jan-2010 28-Feb-2014

$86,264  **Fernando Muzzio**  
HALDOR TAPSOE A/S - Effects of compressi  
"Effects of compression parameters on the properties Mg/Al tablets"  
01-Jan-2010 28-Feb-2014

$82,000  **Fernando Muzzio**  
NSF EEC-0540855 5/5 - GRS  
"GRS Supplement for ERC for Structured Organic Particulate Systems"  
16-Sep-2010 30-Sep-2012

$339,474  **Fernando Muzzio**  
JANSSEN ORTHO LLC-Rutgers Support for JO  
"Rutgers Support for JOLLC- Proof of concept of continuous manufacturing direct compression line"  
01-Mar-2011 31-May-2012

$24,640  **Fernando Muzzio**  
ANONYMOUS CORPORATION-AGREEMENT #2  
"Service Testing"  
01-Apr-2011 30-Jun-2013
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<td>COLGATE - PALMOLIVE - MULTISCALE SIMULAT</td>
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<td>01-Oct-2007</td>
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<td>&quot;Multiscale Modeling of Permeability of Protective Polyelectrolyte Membranes to CBW Agents&quot;</td>
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<td>$99,999</td>
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<td>ACS - PRF #48890-ND6 - Adsorption and Ch</td>
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<td>01-Jan-2009</td>
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<td>18-Sep-2009</td>
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<td>SNJ-DHSS-CCR-Novel Carrier for Antisense</td>
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$300,000  
**Charles Roth**  
NSF ARRA EEC 0851831 1/1 REU  
"ARRA: REU Site: Cellular Bioengineering - From Biomaterials to Stem Cells"  
01-Sep-2009  
30-Nov-2012

$509,590  
**Charles Roth**  
USA MED RESEARCH ACQ ACTIVITY-W81XWH-10- "Integrated Proteomic Analysis and siRNA Therapy for the Treatment of Heterotopic Ossification (Peer Reviewed Ortho Rsch Pgm PRORP)"  
30-Sep-2010  
31-Jan-2013

$424,866  
**Charles Roth**  
NIH ARRA 5 R01 EB008278-07  
Efficient Cellular Delivery of Oligonucleotides  
01-Jul-2010  
30-Sep-2012

$15,937  
**Rohit Ramachandran**  
BRISTOL-MYERS SQUIBB  
Crystallization Characterization via population Balance Modeling.  
10-Nov-2011  
09-Nov-2012

$12,000  
**Nina Shapley**  
CAFT-MEMBERSHIP-FOOD SAFETY AND DEFENSE  
"Food Safety and Defense"  
01-Jul-2009  
30-Sep-2012

$244,325  
**Nina Shapley**  
NSF CBET-1006461 1/1  
"Formation of Multiscale Biopolymer Particle Structures for Novel Biosorbent Design"  
02-Sep-2009  
30-Apr-2012

$114,650  
**Nina Shapley**  
NSF CBET 1005778 1/1  
"Collaborative Research: Understanding UV Protective Mechanisms Using Hybrid Nanoarchitectures"  
02-Sep-2009  
31-Aug-2012

$361,254  
**Nina Shapley**  
USDA-2011-65210-20046  
"Developing "Green" Technology for Eliminating Foodborne Pathogens"  
01-Jan-2011  
31-Mar-2014

$450,000  
**Stavroula Sofou**  
Career Catalyst Award, Susan G. Komen for the Cure  
"Multiresponsive Liposomes for the Targeted Therapy of Breast Cancer"  
01-Oct-2008  
31-Jun-2012

$1,218,750  
**M. Silvina Tomassone**  
NSF NIRT 0506722  
"Environmentally Benign Deagglomeration and Mixing of Nanoparticles"  
01-Aug-2006  
31-Jul-2012
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Johnson & Johnson Co. $20,000 For Distinguished Lecturer Seminar Series
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Scholarships Created from Corporate and Alumni Contributions

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<td>Dr. Bhavender P. Sharma</td>
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<td>Mr. Harold D. Toepfer</td>
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<td>‘84 MS ‘88</td>
<td>Ms. Amy Tsui</td>
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<td>Dr. David A. Vaccari</td>
<td>MS ‘83, PhD ‘84</td>
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<td>Mr. Evan L. Snyder</td>
<td>‘84</td>
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<td>‘87, MS ‘94</td>
<td>Mr. Stanley R. Zwiebel</td>
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