

Kansas Board of Regents
Application for New Program

Name of Submitting Institution:

PITTSBURG STATE UNIVERSITY

Address:

1701 SOUTH BROADWAY – PITTSBURG, KS 66762

Contact Person:

Dr. Petar R. Dvornic
Chair, Department of Chemistry

New Program Title:

MASTER OF SCIENCE IN POLYMER CHEMISTRY

CIP: 40.0507

Anticipated date of implementation: Spring Semester 2015
Department of Chemistry

1. PROGRAM PROPOSAL NARRATIVE

a. Program Need and Student Characteristics

(1) Is the program central to the mission of the institution?

In Fall of 2011, Pittsburg State University (PSU), with endorsement from the Kansas Board of Regents, proposed a Polymer Initiative to Governor Sam Brownback and the Kansas Legislature involving a partnership between academic units at PSU with the Kansas Polymer Research Center (KPRC) located on our campus. This initiative received \$ 0.5 million financial support from the State in FY13 which increased to \$ 1 million recurring budget as of FY14 annually added to the University's base funding to support this enterprise.

The proposed *Master of Science in Polymer Chemistry* is one of the central aspects of the Polymer Initiative and directly relates to the KBOR-approved mission of Pittsburg State University. More specifically, the proposed program relates to the economic development language in our mission through training students to assume positions, particularly leadership positions, in polymer-related industries, as well as to have increased chances of qualifying for corresponding Ph.D. programs in leading institutions and universities nationally and abroad. For example, graduates of this new degree program will be on the cutting edge of converting bio-based raw materials into various commodities and/or specialty products. Due to the involvement of academic programs in Chemistry and Plastics Engineering Technology, and research partnership with Kansas Polymer research Center (KPRC) in this program, we are in a unique position in Kansas, as well as the region, to offer a program reflecting the agricultural base of our state. This effort will, therefore, have direct economic development implications for our future graduates, their employers, and the southeast region of Kansas. The proposed program reflects direct relationships between the University, business, and industry, all central to the mission.

(2) What is the student demand for the program?

The Master of Science in Polymer Chemistry will provide an ideal context for training undergraduate students in an area of potentially high future industrial growth given the agricultural base of Kansas. Graduates will possess skills necessary for successful careers in businesses involved with polymers development and production. Students will receive training in polymer chemistry through coursework, laboratories, research experiences, and other hands-on education. By doing this, the University not only saves polymer companies time and money due to not having to train employees and have them learn on the job, but our graduates will also have an advantage on the job market due to this specific advanced training. Preparing students for contemporary lucrative careers is enhanced by offering a degree in polymer chemistry joining the resources, laboratories, and scientists at KPRC with the resources and faculty available in the PSU Department of Chemistry and the Plastics Engineering Technology program.

We anticipate three full-time students in the first year of implementation, with the program growing to 12 full-time and 2-4 part-time students by the fifth year. These projections are based on surveying current students in the Chemistry major to determine interest in a new graduate degree program focusing specifically on polymer chemistry. Given the unique nature of the proposed degree program in this region of the United States, along with outstanding employment potential upon graduation and training for continued graduate

education towards the Ph.D., we predict full-time enrollment will double in the second year and then increase further in the third and following years.

(3) What is the demand for graduates of this program?

The polymers and plastics industries are among the largest employers of high tech, high value jobs for science majors. In fact, the American Chemical Society Division of Polymer Chemistry projects 50% of all chemists work with polymers at some point in their career. In the absence of a formal polymer chemistry academic program the burden for training falls on polymer companies and new employees must learn on the job. Further, this program provides industry the opportunity to grow and develop at a faster pace through a better prepared workforce.

The United States Bureau of Labor Statistics predicts a 10% increase in employment opportunities for materials scientists through 2020. The median annual salary in 2010 for these positions was \$69,790, well above the median for all occupations in the U.S. (\$33,840). Further, according to the Kansas Department of Labor 2020 employment projections plastics and rubber products manufacturing should see a 12.6% increase in employment. Further in Kansas, it is predicted chemist positions will increase 4.5% by 2020 and earn a median salary of \$57,080. The master's degree is an advanced educational attainment for these positions at both the state and national levels.

The Kansas economy is based on agriculture, particularly producing corn and soybeans, and as a result KPRC has an established history using and converting these raw materials in the development and production of polymers, including but not limited to plastics, synthetic fibers, agricultural chemicals, paints, adhesives, inks, construction materials, and packaging. Polymers also have biomedical applications including artificial skin, prosthetics, the nicotine patch, and the delivery of cancer-fighting medications. Educating students in this development and production process prepares highly skilled workers to step directly into industry, no longer requiring companies to train their workers in basic concepts and processes, ultimately saving time and expediting the innovation, development, and production process.

While KPRC has an established history partnering with industry, PSU has a strong record providing high quality education in the areas of chemistry and plastics engineering technology. Joining and enhancing these units creates a unique and valuable arrangement for students, the region, and economic development in the state of Kansas.

We discussed the idea of creating this graduate degree program in polymer chemistry (building upon the previously approved unique undergraduate program in the same discipline) with representatives from local industry, recruiters for technical positions, and current university partners. There is universal agreement that polymer chemistry is a valuable and unique background, setting Pittsburg State graduates above their competitors as they seek job opportunities in plastics, polymers, and composites manufacturers as well as in various formulators, packaging, engineering materials and the CASE (coatings, adhesives, sealants, and elastomers) industries.

It is also true that the knowledge and ability to make predictions and employ structure-property relationships in problem solving is one of the more valuable benefits of this focused field of study, which directly translates into a benefit for employers. A polymer chemist has

first-hand knowledge of how the structure of materials translates into specific properties of the final products. Our graduates will prove invaluable to companies and corporations involved with the development and production of polymer products.

Employers are also looking for chemists who can do more than just “follow a recipe.” As conceived, this program will include significant exposure to laboratory work as well as polymer processing and manufacturing operations. This is made possible by uniquely joining expertise and facilities available in our Department of Chemistry (science and synthesis), KPRC (research and characterization) and Department of Plastics Engineering Technology (processing and engineering). These experiences will include hands-on training and exposure to relevant polymer technologies through internships and undergraduate research. The students will demonstrate initiative, creativity, and a multidisciplinary self-starting attitude, which are additional valued traits in the chemical industry.

4. What are the locational and comparative advantages of this program?

PSU is in a unique position to create and implement a new graduate degree program in polymer chemistry due to the strong and established Chemistry Department in the College of Arts and Sciences, Plastics Engineering Technology Department in the College of Technology and KPRC as a professional research institution. This educational-research partnership provides the foundation for a unique and multi-faceted degree program at Pittsburg State. Given the promising future of polymer science, the relevance of this field for the Kansas economy, the lack of other polymer science programs in the state and region, and the obvious link between the aforementioned units, it makes perfect sense for PSU to offer this degree program with high hopes for expected success.

This proposed graduate program, coupled with the new undergraduate degree program in polymer chemistry, places PSU in a very small group of higher education institutions providing students with an academic background in this cutting edge, high tech, and contemporary discipline. It will also become a unique “bridge” towards the higher level Ph.D. programs in polymer science and engineering offered by some of the world class universities in the United States including the University of Massachusetts, Southern Mississippi University, and the University of Akron.

5. What are the characteristics of the students who will participate in this proposed program?

This program will primarily target students finishing the undergraduate polymer chemistry program at Pittsburg State University, but also those who graduate from other universities in Kansas, the United States, and from around the world with degrees in sciences (including chemistry, physics and biology), engineering, and materials technologies.

Students entering this program and career field should prepare themselves with a strong record and coursework in science and have either career interests in companies working with polymers for production or a desire to pursue the highest academic degrees at institutions offering a doctorate in polymer science and engineering in the U.S. or abroad.

b. Curriculum of the Proposed Program.

- (1) What is the curriculum of the proposed program?

The Master of Science in Polymer Chemistry is a 31 credit hour degree program consisting of 9 credit hours of core polymer courses, 10 credit hours of research work and colloquium, and 12 credit hours of elective polymer courses selected in consultation with the academic advisor.

The proposed coursework was reviewed and approved by faculty in the Department of Chemistry and the Plastics Engineering Technology Program as well as by the Graduate School of Pittsburg State University. The curricular outline is provided later in this proposal package.

The proposed program includes five objectives centered on preparing students either for work in the polymers industry or advanced graduate education in this field. After completing the program students will:

- 1) have an understanding of polymers and other related materials and their applications in industry and everyday life.
- 2) acquire sufficient advanced knowledge to begin careers in the field of polymer science and engineering.
- 3) develop the ability to lead research and development projects in polymer-related industries.
- 4) be able to explain physical, chemical, and other properties of polymers in real-world applications.
- 5) develop expertise using various modern instruments used in cutting-edge polymer research.
- 6) succeed on qualifying exams for acceptance to leading Ph.D. programs at universities in the U.S. and around the world.

All polymer science masters candidates will be required to complete significant mentored research projects.

c. Program Faculty.

(1) What is the quality of the faculty?

Four new core polymer science faculty were hired during the last year by PSU specifically for the Polymer Initiative program. These include a new full Professor, Dr. Petar R. Dvornic (terminal degree) hired as Chemistry Department Chair who will also coordinate the Polymer Chemistry Initiative program, and three new full-time tenure earning Assistant Professors: Dr. Ram Gupta (terminal degree), Dr. Santimukul Santra (terminal degree), and Dr. Jeanne Norton (terminal degree).

Beyond the core faculty listed above Dr. Charles Neef (terminal degree) from the Chemistry Department as well as Mr. Bob Susnik and Mr. Paul Herring from the Plastics Engineering Program in the College of Technology will offer elective courses as support faculty. It is also expected that various other faculty from the College of Arts and Sciences and KPRC may provide foundational coursework as needed, including faculty from the departments of physics and biology. All core faculty have terminal degrees, post-doctoral experiences, and significant academic accomplishments (external funding, industry experience, publications, professional presentations, technical reports, etc.). Their vitae are available upon request.

All faculty specifically hired for the PSU Polymer Chemistry Initiative program are funded through the annual allocation endorsed by KBOR and provided by the Kansas Legislature and Governor. The annual cost of these new faculty lines, including salary and benefits, is \$395,000.

- (2) How many graduate assistants will serve the program?

The PSU Polymer Chemistry Initiative budget provides funding for three graduate assistants who will assist faculty with courses and oversee student laboratory experiences. The annual aggregated cost of these graduate assistants is \$41,000 (includes stipends and tuition waivers).

d. Academic Support.

- (1) What are the academic support services for this program?

Academic services at PSU, including advising, library, audio-visual, laboratory, and academic computing resources, are sufficient to support this program. All academic support available at PSU and in the College of Arts and Sciences will be available for students and faculty in the Master of Science in Polymer Chemistry program, including institutional support, initiatives offered through the Student Success Center (such as The Writing Center), resources available through the Axe Library, access to support for faculty and student travel, and internal grant funding opportunities.

In addition, Pittsburg State University provides strong and outstanding support for both hardware and software technology needs. The Department of Chemistry in the College of Arts and Sciences, the Plastics Engineering Technology Program in the College of Technology, and the Kansas Polymer Research Center will provide equipment, lab-space, and support infrastructure, including information and communication resources, to students and faculty in this proposed program.

- (2) What new library materials and other forms of academic support are required beyond normal additions?

Library material, including electronic subscriptions to the most relevant journals and databases in polymer science, are sufficient for the proposed program at this time. If future needs are determined, funding for this purpose is identified in the recurring \$1 million allocation for the PSU Polymer Initiative.

- (3) What new supporting staff will be required beyond normal additions?

Current support staff in the College of Arts and Sciences (technology support consultants, instructional support specialist, electronic technologist, development officer) and the Department of Chemistry (administrative assistant, supply room supervisor) is sufficient for the proposed program at this time. In addition, the PSU Polymer Initiative provides a .50 FTE administrative assistant/budget officer for support at an annual cost of \$18,000 (salary and benefits). This support position is in addition to the existing Administrative Assistant in the Department of Chemistry.

e. Facilities and Equipment.

- (1) What are the anticipated facilities requirements (existing, renovated or new)?

Existing facilities are sufficient for the proposed program at this time. The program will use classrooms and labs in the Department of Chemistry, the Plastics Engineering Technology Program, and KPRC.

- (2) What new equipment will be required beyond normal additions?

There are additional significant equipment needs for this graduate degree program as well as the overall PSU Polymer Initiative. These needs will be met through existing equipment and facilities at KPRC, the Chemistry Department, and the Plastics Engineering Technology program in the College of Technology, as well as funds from the \$1 million recurring state allocation. Budget lines exist in the allocation to cover faculty start-up needs and purchase research/instructional equipment along with materials such as chemicals and other consumables.

Specifically, we need to purchase a Benchtop Mini-MRI (\$50,000), Zeta-Sizer (\$40,000), a Sputtering Thermal Evaporator (\$90,000), and Elipsometer (\$30,000), a Contact Angle Measurement Unit (\$15,000), an Atomic Force Microscope (ca \$100,000) and a Reverse Osmosis Testing Unit (ca \$20,000). The proposed program will be able to use the following equipment already existing in the Department of Chemistry at PSU: FT-IR Spectroscopy, UV-Visible Spectroscopy, Fluorometer, Atomic Absorption Spectrometer, Polarimeter, and NMR Spectroscopy. Further, KPRC currently owns the following equipment that will be used in offering the proposed program: High-Pressure Liquid Chromatography, Gel-Permeation Chromatography, Powder X-Ray Diffraction, Scanning Electron Microscopy, Differential Scanning Calorimetry, Dynamic Mechanical Analysis, Thermomechanical Analysis, Thermogravimetric Analysis, Dielectric Thermal Analysis, Ultra Pyconmeter, and Viscometer/Rheometer, Semiconducting Characterization System, Potentiostat for Polymerization Electrospun for Nanofibers.

f. Program Review, Assessment and Accreditation.

- (1) What program review process or evaluation methods will be used to review the program?

This graduate degree program will employ the same program review procedures used for all PSU programs. In addition, all programs, including the proposed Master of Science in Polymer Chemistry, are required to submit an annual assessment report to the University Assessment Committee documenting progress towards meeting student learning outcomes.

- (2) What student learning outcomes measures will be used to assess the program's effectiveness?

The program level assessment for the Master of Science in Polymer Chemistry degree will be consistent with other programs in the College of Arts and Sciences following the same basic model used for the current Master of Science in Chemistry. Faculty in the new program will work with the PSU Director of Assessment to continue refining program assessment methods as the new degree program is implemented. Assessment techniques will include the use of research lab reports, colloquium projects scored with rubrics, thesis prospectus, thesis defense reviews, advisement surveys, exit interviews, and employment surveys.

(3) What are the institution's plans regarding program accreditation?

The Department of Chemistry at PSU is approved by the American Chemical Society (ACS). The Department will use current ACS guidelines to oversee the proposed academic program in polymer chemistry and seek ACS approval for the new program when it is implemented.

**Kansas Board of Regents
New Degree Request**

Institution: PITTSBURG STATE UNIVERSITY

<u>Criteria</u>	<u>Program Summary</u>
1. Program Identification:	Master of Science in Polymer Chemistry CIP: 40.0507
2. Academic Unit:	Department of Chemistry/College of Arts and Sciences
3. Program Description:	<p>This proposed program provides graduate students access to cutting-edge knowledge, research, and laboratory-based experience in the field of polymer chemistry. Students completing this program will be prepared for careers in high-tech polymers-based industries as well as laboratories in academic institutions, government, and private research settings. Further, this program prepares students for advanced academic study pursuing a doctorate in polymer science in major U.S. and world universities.</p> <p>The program was developed as a result of the Pittsburg State University (PSU) Polymer Initiative, which was supported by Governor Sam Brownback and the Kansas Legislature. An important aspect of this initiative is creating, offering, and awarding a Master of Science in Polymer Chemistry. This proposal received initial funding from the Legislature and Governor in FY13 and FY14, with the promise of a recurring \$1 million annually added to the University's base funding to support the Polymer Initiative.</p>
4. Demand/Need for the Program	<p>PSU is in a unique position to create and implement the Polymer Initiative due to the presence of the Kansas Polymer Research Center (KPRC) on our campus. Given the promising future of polymer science, the relevance of this field for the Kansas economy, the lack of other polymer science programs in the region, and the obvious unique link between PSU and KPRC, it makes sense for PSU to offer a graduate degree in polymer chemistry.</p> <p>KPRC has an established history taking the agricultural products of Kansas and turning them into polymers usable in industry. PSU has an established record providing high quality education in the areas of chemistry and plastics engineering. Joining and enhancing these units into a whole that is larger than the sum of its individual parts creates a valuable arrangement for our students, the region, and economic development in Kansas.</p> <p>The polymers and plastics industries are among the largest employers of high tech, high value jobs for science majors. The U.S. Bureau of Labor Statistics predicts a 10% increase in employment opportunities for material scientists through 2020 with a median annual salary of \$69,790. Further, the Kansas Department of Labor employment projections claim jobs for people in plastics and rubber manufacturing to increase 12.6% and chemists to increase 4.5% by 2020. The median annual salary for these positions is \$57,080. The typical entry level degree requirements for jobs in these areas is the bachelor's degree but more and more Master of Science skills are expected as the science develops further. In fact, the American Chemical</p>

Society Division of Polymer Chemistry projects 60-70% of all chemists work with polymers at some point in their career. At present the burden for training workers to reach desired levels of skill and expertise often falls to polymer companies and new employees must learn on the job. Students with this training through coursework, laboratories, research experiences, and other hands-on education not only saves companies time and money, but also have an advantage in the job market. This proposed program provides industry the opportunity to grow and develop at a faster pace. Training students for these contemporary lucrative careers is significantly enhanced by offering a M.S. degree program in polymer chemistry joining the assets, laboratories, and scientists of KPRC with the resources and faculty available in the PSU Department of Chemistry and Plastics Engineering Technology program.

5. Comparative/Locational Advantage

There is no other degree program offered at a university in this region focusing specifically on polymer chemistry. Further, the presence of KPRC on the PSU campus provides exceptional resources when coupled with the academic assets in our Department of Chemistry and program in Plastics Engineering Technology. This combination creates a very unique and ripe environment for further expanding hands-on research experiences in a Master of Science degree program in polymer chemistry.

If approved, this program will put PSU in a small group of higher education institutions across the country providing students with an academic background in this cutting edge, high tech, and contemporary discipline. Other institutions in the United States offering this type of program include the University of Massachusetts, Southern Mississippi University, University of Akron, and Case Western Reserve University.

6. Curriculum

The Master of Science in Polymer Chemistry is a 31 credit hour graduate degree program consisting of 9 hours of core polymer courses, an additional 10 credit hours of research work and colloquium and 12 credit hours of elective polymer courses selected in consultation with the academic advisor. All polymer science master's candidates will be required to complete and defend a research thesis.

7. Faculty Profile

Dr. Petar R. Dvornic (terminal degree) was hired as Chemistry Department Chair and will coordinate the program. In addition, Dr. Ram Gupta (terminal degree), Dr. Santimukul Santra (terminal degree), and Dr. Jeanne Norton (terminal degree) were hired to staff the new PSU Polymer Initiative and each will be primary and core faculty in the proposed Master of Science in Polymer Chemistry.

Dr. Charles Neef (terminal degree) from the Chemistry Department as well as Mr. Bob Susnik and Mr. Paul Herring from the Plastics Engineering Program in the College of Technology will offer elective courses as support faculty. It is expected that various other faculty from the KPRC and the College of Arts and Sciences will provide foundational coursework as needed, including faculty from the departments of physics and biology.

All core faculty have terminal degrees, post-doctoral experiences, and significant academic accomplishments (external funding, industry experience, publications, professional presentations, technical reports, etc.). Their vitae are available upon request.

The four core faculty lines are new and cost \$395,000 (salary and benefits). Funding for the new lines comes from the \$1 million annual allocation from the Kansas Legislature for the PSU Polymer Initiative.

In addition, the PSU Polymer Initiative budget provides three graduate assistants, at an annual cost of \$41,000, who will assist faculty with courses and oversee undergraduate

student laboratory experiences.

8. Student Profile

Students entering this academic program and career field should prepare themselves with a strong undergraduate coursework in science, preferably in chemistry, chemical engineering, plastics technology, biology or physics. Students will be admitted to the polymer chemistry master's program if they meet the Pittsburg State University admission criteria. These students will have career interests in companies working with polymers for production and/or have a desire to pursue the next level of graduate education at one of the prominent polymer science Ph.D. programs in the United States or abroad.

9. Academic Support

All academic support at Pittsburg State University and the College of Arts and Sciences will be available for students and faculty in the polymer chemistry graduate program. Available support includes faculty development programs, initiatives offered through the Student Success Center (including the Writing Center), resources available via Axe Library, access to support for faculty and student travel, and internal grant funding opportunities. In addition, Pittsburg State University and the College of Arts and Sciences provide outstanding support for both hardware and software technology needs.

Students will also have access to the equipment and expertise of scientists at the Kansas Polymer Research Center (KPRC) as well as equipment and lab space in both the Department of Chemistry and the Plastics Engineering Technology program in the College of Technology at Pittsburg State.

10. Facilities & Equipment

This proposed Master of Science in Polymer Chemistry has significant laboratory and equipment needs. These needs are met through existing facilities and equipment available at the KPRC, the Chemistry Department, the Plastics Engineering Program, as well as completed renovations to the Chemistry Department suite in Heckert-Wells Hall.

11. Program Review, Assessment, Accreditation

The Department of Chemistry at PSU is approved by the American Chemical Society (ACS). It will use existing ACS guidelines to oversee the proposed academic program in polymer chemistry. The Master of Science in Polymer Chemistry will also be reviewed according to the regular program review cycle and process at Pittsburg State University. Further, all degree programs at the University are required to submit an annual assessment report to the University Assessment Committee documenting progress towards meeting student learning outcomes.

12. Costs, Financing

Funding for this new academic program is included in the \$1 million recurring annual allocation provided by the Kansas State Legislature and Governor. These funds provide four new faculty lines (\$395,000 annually), start-up and equipment procurement (\$550,000 one-time expense), graduate assistants (\$41,000 annually), support staff (\$18,000 annually), and operations and acquisition of materials (\$530,000 annually).

CURRICULUM OUTLINE
NEW DEGREE PROPOSALS
Kansas Board of Regents

I. Identify the new degree: Master of Science in Polymer Chemistry

II. Provide courses required for each student in the major:

Course Name & Number	Credit Hours
<u>Core Polymer Science Courses (9 hours)</u>	
CHEM 730 Advanced Polymer Chemistry	3
CHEM 785 Physical Chemistry of Polymers	3
PET 883 Polymer Rheology and Processing	3
<u>Polymer Core Research and Colloquium (10 hours)</u>	
CHEM 890 Research and Thesis	6
CHEM 790 Advanced research in Polymer Chemistry	3
CHEM 801 Chemistry Colloquium	1
<u>Electives (Select appropriate number of courses to fulfill the total credit requirement):</u>	
CHEM 887 Advanced Biopolymers and Nanotechnology	3
CHEM 840 Advanced Polymers for Electrical and Electronic Applications	3
CHEM 850 Inorganic and Architecturally Unusual Polymers	3
CHEM 889 Intro to chemical research	3
PET 673 Advanced Injection Molding	3
PET 885 Advanced Polymer Composites	3
ETECH 888 Design of Experiments	3
Total credit requirement:	31 hours

IMPLEMENTATION YEAR FY 2015-2016

Fiscal Summary for Proposed Academic Programs

Institution: PITTSBURG STATE UNIVERSITY

Proposed Program: Master of Science in Polymer Chemistry

Part I. Anticipated Enrollment	Implementation Year		Year 2		Year 3	
	Full-Time	Part-Time	Full-Time	Part-Time	Full-Time	Part-Time
A. Full-time, Part-time Headcount:	3	0	8	0	12	0
B. Total SCH taken by all students in program	54		144		216	
Part II. Program Cost Projection						
A. In <u>implementation</u> year one, list all identifiable General Use costs to the academic unit(s) and how they will be funded. In subsequent years, please include only the additional amount budgeted.						
	Implementation Year		Year 2		Year 3	
<u>Base Budget</u> Salaries	\$403,134		\$403,134		\$403,134	
OOE	\$596,866		\$596,866		\$596,866	
Total	\$1,000,000		\$1,000,000		\$1,000,000	

Indicate source and amount of funds if other than internal reallocation:

Funding for the Master of Science in Polymer Chemistry is provided through the \$1 million targeted annual allocation from the Kansas Legislature for the Polymer Initiative at Pittsburg State University.