

Engineering and Technology Industry Council Excellence Initiative Biennium from July 1, 2003 to June 30, 2005

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Submission Date: October 20, 2003

Summary of Proposal:

A Collaborative Bachelor's Degree in materials science that leads to a 4 + 1 Master's degree

Goals

The goal of this proposal is to provide a materials science option for at both Southern Oregon University and the University of Oregon. We aim to train students in the basics of materials science and offer them a chance to explore more advanced properties of some special materials such as electronics materials and polymers to meet anticipated industrial needs for effective researchers/problem solvers in the microelectronics and the polymer/coatings industry. For example, as devices become smaller, surface chemistry and fundamental physical limits become more challenging. Our proposed program is modeled after Rochester Institute of Technology's Microelectronics degree program and takes advantage of the Materials Science Institute's (MSI) already strong graduate materials program. The proposed program's focus on developing a strong basic science core of knowledge with an engineering 'veneer' complements the engineering based programs at PSU and OSU. We expect graduates from this program to be capable of entering the work force as well as continuing their education in other Oregon institutions. Students are beginning to realize the importance of materials science in the manufacturing and the high-tech industry and the possible financial rewards.

In anticipation of ETIC support, SOU has already received approval for a Materials Science option in the Physics degree, and students can start the program now. However, because of less than full funding, we propose to devote the 2003-04 academic year to recruiting students and faculty to the program and to begin the program in earnest during the 2004-05 academic year. By delaying a year, we will build a full capacity program for 2004-05 rather than run a smaller program for two years. The U of O predicts a steady state of 15 to 20 graduates from its program and SOU should be able to achieve a steady state of 10 to 15. Considering the capacity in the U of O Master's program, the combined 25 to 35 graduates constitute a reasonable feeder population considering that some proportion will opt for direct employment after the BS. We plan to market the degree program as the initial component of a 4+1 Master's degree in which students who earn their undergraduate degree with the necessary GPA and recommendations from faculty will have a strong chance to be allowed to complete the Master's component at the University of Oregon. An additional focus of the proposed undergraduate program is the expectation that students will conduct undergraduate research. To compensate for the reduced ETIC funding, MSI plans on submitting an NSF proposal to the "Undergraduate Research Centers (URCs)" program will seek ~\$2,700,000 over 5 years to leverage the requested ETIC funds, expanding parts of the proposed program to include other academic institutions in the state. The URC program is a pilot program that seeks new models and partnerships with the potential (1) to expand the reach of

undergraduate research to include first- and second-year college students; and (2) to enhance the research capacity, infrastructure, and culture of participating institutions, thereby strengthening the nation's research enterprise. This grant will leverage the UO equipment request and the administrative support requested will be used for the preparation and implementation of the URC.

Investment Rationale

This is a joint proposal between SOU and the U of O designed to enable both institutions to develop nationally recognized materials programs for undergraduate students. The goal is to decrease duplication and increase efficiency while permitting students to matriculate on their home campuses. We believe this is the first such collaborative arrangement between OUS campuses and it is readily extendable if other campuses wish to join this proposal. We proposed to invest \$1.00 m over the biennium at both U of O and SOU, with funding split approximately 60% to the U of O and 40% to SOU.

At the \$520,000 funding level, we propose to delay full implementation of the program until 2004-05 at SOU and to use 2003-04 to recruit students and faculty. However, interested students can enter the already approved program at SOU immediately. SOU will hire 1.5 FTE new faculty positions starting in fall 2004, to teach additional courses and to complement the existing expertise in the Chemistry and Physics Departments; start-up funds for creating the lab components of the materials science courses, and half of a new technical support staff position. We envision the persons filling the new faculty positions to have expertise in one or more of the following areas: composites, ceramics, nanomaterials, metallurgy, polymers, or biomaterials. Faculty members in these areas will fit in well with our existing faculty (see original excellence proposal). The new faculty will be responsible for offering an advanced materials course in their area of expertise and contributing to the new materials science sequence, discussed below, along with current faculty.

At the \$520,000 funding level, we propose to delay full implementation of the program until 2005-2006 at U of O. During the current biennium, the requested funds will be used as matching funds for a NSF URC proposal. The requested funds will be used for a program coordinator that will work with both SOU and U of O departments and students to facilitate the inter-campus aspects of the proposed program, work with faculty to write the URC proposal, and, if this is successful, implement the proposed plan. The equipment funds will also be used to create the undergraduate materials laboratory that will be taught in the summers at the U of O by SOU and U of O faculty for students from both campuses. This laboratory is envisioned to be a gateway course enabling undergraduates to participate in undergraduate research early on in their undergraduate careers. We anticipate leveraging these funds by using them as match for federal grants aimed at improving undergraduate laboratories, the NSF URC program, and the NSF Discovery Corps Fellowships.

Both Universities will offer scholarships to recruit students and to assist them with the cost of commuting to another campus. SOU's scholarships will start in 2004-05 and U of O's scholarships will start in 2005-06.

The proposed program for students reflects the collaborative nature of the proposed program. We plan to offer a lecture/laboratory course sequence in materials science, opened to SOU and U of O students who have completed their general chemistry and physics sequences, which will be taught in the summers at the University of Oregon by SOU and U of O faculty. This takes advantage of the existing

facilities at the U of O, enable SOU faculty to use the research facilities at the U of O, and provides an opportunity for faculty to interact on research projects and teaching. During a second summer, students from both campuses will take a summer sequence of introductory engineering courses at SOU. Students will take additional advanced courses in materials (e.g., strength of materials, physical chemistry, solid-state physics), and other elective courses (e.g., statics, dynamics, analog and digital electronics, and instrumentation). The materials science sequence will be a new component but most of the other courses are currently offered at SOU and U of O, although the proposed new degree option will require that they be offered more frequently. Additional materials related topics will also be introduced in existing lecture and laboratory courses. Laboratory topics to be introduced to advanced chemistry and physics lab course include vacuum technology, fabrication techniques such as evaporation and CVD, and analysis techniques such as using the SEM, FTIR, DTC, etc. This component is extremely important because materials science is a hands-on subject and student must learn to study and test materials. A strong laboratory experience is a hallmark of SOU's physics and chemistry programs and ensures the marketability of the graduates. Undergraduate research will be strongly encouraged at both SOU and the U of O.

Results

The result of ETIC support will be the beginning of a top rated undergraduate materials program to meet anticipated industrial needs for effective researchers/problem solvers in the microelectronics and the polymer/coatings industry. The new materials faculty at SOU will be expected to develop nationally competitive research programs and synergistically aid the already strong research efforts within MSI at the U of O. We anticipate a program with approximately 20-30 majors graduating a year between the two institutions. Following the successful recruitment of students and faculty during 2003-04 and the start of the program in 2004-2005, we anticipate requesting ETIC support for a faculty member at the U of O to handle the additional upper level teaching demands in the 2005-2007 biennium.

This program will be very efficient, producing 10-15 additional graduates per additional faculty member hired, because the core of the program is a blending of the existing physics and chemistry curricula and because of the collaboration between SOU and U of O. The proposed materials program complements the existing engineering programs at PSU and OSU. We will welcome students from other campuses to our summer courses. We believe this program will build collaborative bridges between the OUS institutions.

SOU has already established the program as an option under its existing physics bachelor's degree. Based on initial success of program, we plan to establish a stand-alone degree program subject to OUS approval. The graduates from this program should be able to integrate directly into the industrial sector. At the same time, we will work with the Materials Science Master's Degree Programs at UO and OSU to provide postgraduate degree options for our graduates as well as strengthening our collaboration between the institutions.

Sample BS/MS 4 + 1 Materials Program:

YEAR 1

Chemistry 221, 222, 223
Mathematics 251,252,253
Physics 211, 212, 213
Materials Laboratory

General Chemistry
Calculus
Foundations of Physics I
NEW COURSE SEQUENCE

YEAR 2

Chemistry 331, 332, 333
Chemistry 337, 338, 339
Mathematics 256,281,282
Physics 351,352
Summer program in Materials Engineering

Organic Chemistry
Green Organic Chemistry Laboratory
Diff. Equations, Multivariable Calculus
Foundations of Physics II: waves
NEW COURSE SEQUENCE

YEAR 3

Chemistry 411, 412
Physics 411, 412, 413
Physics 414,415
Chemistry 417 418, 419
or Physics 390

Physical Chemistry
Mechanics, Electricity and Magnetism
Quantum Physics
Physical Chemistry Lab
Intermediate Physics Laboratory

YEAR 4

Chemistry 431,432,433
Physics 431,432,433
Physics 424, 425, 426
Materials 411, 412, 413

Inorganic/Solid State Chemistry
Analog and digital electronics
Optics and optics laboratory
Materials I and II, Lithography,
NEW COURSES

YEAR 5

Semiconductor Device Physics or Polymer Characterization
Semiconductor Processing Polymer Physics
Semiconductor Laboratory Polymer Laboratory
INDUSTRIAL INTERNSHIP/APRENTICESHIP

NOTE: Course numbers above are from the U of O, but analogous courses are already being taught at SOU under different numbers.

Proposed Investment and Private Support Forecast for Both Universities (\$M)

	7/1/03- 6/30/04	7/1/04- 6/30/05	Total
Proposed OUS Investment (\$M)			
New programs (3):			
SOU Faculty Positions	\$0.031	\$0.091	\$0.122
SOU MS teaching and res. labs	\$0.013	\$0.050	\$0.063
U of O Program Coordinator	\$0.020	\$0.020	\$0.040
U of O Mat. Sci. Teaching laboratory	\$0.110	\$0.150	\$0.260
Student Scholarships/Recruiting SOU	\$0.005	\$0.030	\$0.035
Subtotal - SOU	\$0.049	\$0.171	\$0.220
Subtotal - UO	\$0.130	\$0.170	\$0.300
Expected private support (\$M)-SOU (4)	\$0.098	\$0.342	\$0.440
Expected private support (\$M) - UO (4)	\$0.260	\$0.340	\$0.600
Total (\$M)	\$0.537	\$1.023	\$1.560
New Faculty Supported (FTE) (5)	0.86	1.86	1.86
Notes:			

Metrics Forecast for SOU:

	Baseline	Projected			
	AY 99	AY04	AY05	AY06	AY09
Total research expenditures per year	\$45,000	\$75,000	\$100K	\$150K	\$200K
National ranking of Materials Science Program (7)	?	see UO	see UO	see UO	see UO
National ranking of SOU School of Sciences (8)	top 1/2	top 1/3	top 1/3	top 3	top 3
Materials Science bachelors degrees granted (10)	0	0	5	10	15
Licenses sold (9)	N/A	N/A	N/A	N/A	N/A
Notes:					
(7) We will attempt to rate the collaborative program (i.e., the combined activity of SOU and the U of O in the relevant areas) in terms of research funding (See U of O metrics).					
(8) We propose to rank ourselves relative to the OUS list of peer institutions for regional Universities and relative to COPLAC Institutions. See SOU's Investment Proposal for list of peers and discussion of criteria.					
(9) Patent licenses or other royalty-generating intellectual property licenses granted to commercial entities					
(10) SCH data for Materials science Engineering courses included in metrics for SOU Capacity Proposal.					

Metrics Forecast for U of O:

	Baseline	Projected			
	AY 99	AY04	AY05	AY06	AY09
Total research expenditures per year (in thousands)	\$2,880	\$6,000	6,500	7,000	8,000
National ranking of Materials Science Program (7)(10)					
Ranking of total federal expenditures as if all chemistry .	91	top 60	top 50	top 50	top 40
Ranking of total federal expenditures as if all physics .	83	top 60	top 50	top 50	top 40
Ranking of total federal expenditures as if materials dept.	31	top 25	top 25	top 25	top 20
Bachelors degrees granted with materials option (11)	0	0	0	5	15
Licenses sold (9)	0	1	1	1	1
Notes:					
(7) We will attempt to rate the collaborative program (i.e., the combined activity of SOU and the U of O in the relevant areas) in terms of research funding.					
(11) Degrees in chemistry and physics with an option in materials.					

(10) Since the MSI is an institute, not a department, we are invisible to most national rankings. MSI's status as an institute, however, makes it much more able to respond to opportunities. There would be definite losses in MSI becoming a department.

To address the issue of National rankings, we have examined the basis for the ratings given by various sources (US News and World Report, Chemical and Engineering News, ...). While several are based on opinion polls, we believe the most impartial rankings are based on federal research dollars obtained. This data is collected nationally by NSF and is published yearly with breakouts based on disciplines – chemistry, physics and materials. We will determine the federal research expenditures generated by the institute (using the numbers reported to the federal government) and then compare the total dollars from chemistry, physics and materials with those from other institutions across the country. These are hard numbers that cannot be fudged. The figures for academic year 1999 are detailed below.

Total federal research expenditures from MSI faculty - \$2,257,000
 Average federal research expenditures/MSI faculty - \$205,000

To our original proposal we attached the NSF rankings of chemistry, physics and materials research being undertaken in the United States based on federal funding. MSI's funding level would place it 92 with respect to chemistry funding, 84 with respect to physics funding and 31st as a metallurgical/materials department. Given the small number of MSI faculty in 1999 (eleven), these rankings are actually quite good. For example, the chemistry related funds at University of Texas at Austin were generated by more than 60 faculty in both their chemistry and biochemistry departments. If the ranking were done on the basis of average federal research expenditures per faculty to compensate for the different faculty sizes at each institution, MSI would rank approximately 40th, above the University of Texas at Austin.