Development of a Modular Nanomaterials Course for Engineering and Science Majors

Background: Approximately 2 million engineers and scientists will be needed worldwide in the field of nanotechnology within the next decade.ⁱ The growing number of nanomaterials and –technology related articles in both the public sector and in the scientific literature exemplifies the expanding interest in the field and the need for a mature perspective amongst young scientist, engineers and the general public. Exposure of students at all levels in Science and Engineering as well as non-Science and non-Engineering majors is needed to prepare the US for interdisciplinary nature of nanotechnology.

Results: A team of 13 professors from Chemistry, Physics, Biomedical, Chemical, Electrical, and Mechanical Engineering have created a coherent modular nanomaterials course that reflects the interdisciplinary nature of nanomaterials science to be taught for the first time in Spring 2007. Figure 1 shows an overview of the nanomaterials course structure. The course is offered through the chemical engineering department and has been able to draw students from different disciplines. The course content has been implemented in such a way that the modules can be used as lecture material in courses from each of the participating disciplines. Additionally, we have assembled a speaker forum of industrial partners to provide the outside experience part of the course.

Notability of Work: The work is notable because it involves the collaboration of 13 professors from 6 disciplines, who in a team-work approach developed concepts for each of the 7 modules to reflect how nanomaterials-related information is represented in their fields of expertise to yield a coherent syllabus. It is the first effort of this magnitude in the field of nanomaterials and nanotechnology at the City College of New York.

Primary Goal:

Learning: (Cultivate a world-class, broadly inclusive science and engineering workforce and expand the scientific literacy of all citizens.)

The NUE effort at CCNY increases the literacy in nanotechonology amongst undergraduate engineers and scientists. It provides and encourages undergraduate students to do research in nanoscience in departments different from their major. In addition, it promotes undergraduate students to pursue a research career in the field of nanotechnology.

Discovery: (Foster research that will advance the frontiers of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the national as a global leader in fundamental transformational science and engineering.)

The NUE effort at CCNY promotes the interaction between researchers and students at CCNY with leaders in industry in the field of nanotechnology. It also will help to identify and cultivate talent at the early stages of college.

How does this highlight address the strategic outcome goal(s) as described in the <u>NSF Strategic Plan</u> <u>2006-2011</u>?

Promote transformational, multidisciplinary research:

This work promotes a cross-disciplinary research environment by drawing from the areas of science and engineering, namely by coordinating efforts between physics and chemistry with biomedical, chemical, electrical and mechanical engineering. The efforts associated with the organization of the NUE coursework are already promoting collaborations at CCNY.

Further U.S. economic competitiveness.

The NUE effort at CCNY seeks to stimulate innovation by capturing the imagination of undergraduate students and encourages them to explore nanotechnology as a future career path. We anticipate that these students will benefit from their exposure to the course and laboratory work by realizing the potential of nanotechnology to lead to fundamental discoveries and transformative technologies.

Investigate the human and social dimensions of new knowledge and technology.

Our course plan has a distinct component that encourages students to think critically about the societal impacts of transformative nanotechnology. This perspective will be coupled with discussion with industrial partners, where "real-world" applications of nanotechnology must be introduced with an awareness of both the actual medical and environmental consequences and the perceived consequences.

Prepare a diverse, globally engaged STEM workforce.

The City College of New York is a recognized minority serving institution, which serves a diverse undergraduate student body of Hispanic (36%), African American (30%), Asian (23%), and White (21%) students. The NUE nanomaterials course will provide our diverse student body with an opportunity to learn about transformative nanotechnology as an interdisciplinary field overlapping with all STEM disciplines. Interactions with our industrial partners will promote transition into the workforce.

Integrate research with education, and build capacity.

The educational materials prepared and developed in the NUE effort at CCNY will be accessible to other educational institutions via a webpage that will be made public after the material has been tested and assessed in the nanomaterials course. *Does this highlight represent transformative research?* Yes

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ⁱ Roco, M. C. "Converging Science and Technology at the Nanoscale: Opportunities for Education and Training" Nature Biotech. 2003, 21, 1247-1249.