Department of Chemical and Materials Engineering
COLLEGE OF ENGINEERING

SUMMER RESEARCH OPPORTUNITIES
FOR UNDERGRADUATE WOMEN

APPLICATION DEADLINE: March 1, 2010

The Department of Chemical and Materials Engineering is pleased to offer the following research project for the summer of 2009. Interested students are urged to contact the faculty member(s) directing the project that most interests them. By contacting the faculty member, you can discover more about the project, learn what your responsibilities will be and, if possible, develop a timetable for the twelve-week research period.

PROJECT TITLE: Grätzel Solar Cells From Flame Synthesis of Nanomaterials

Professor Greg Beaucage
Department of Chemical and Materials Engineering
492 Rhodes Hall
Cincinnati, OH 45221-0012
Tel: (513) 556-3063
Fax: (513) 556-2773
Email: beaucag@uc.edu or gbeaucage@gmail.com (preferred)

Project Description

Electricity can be directly produced from sunlight through a variety of photovoltaic devices. A simple device was developed by electrochemists in Switzerland in the late 1990's and consists of a thin layer of paint pigment base (titania nanosize powder) sandwiched between clear conductors and immersed in an electrolyte with a small amount of organic dye (for example, blueberry juice has been used). Surprisingly, these simple devices have had efficiencies on the order of the efficiencies for expensive single crystal silicon photovoltaic devices. The problem with the dye sensitized or Grätzel Cell is the expense of synthesis for organic pigments and the restrictions of wet electrolytes. Despite this, Grätzel cells have been produced on a semi-mass scale in flexible reel-to-reel processes. This project seeks to develop a novel solar cell based on the Grätzel design but using inorganic pigments made simultaneously with production of titania nanoparticles in a flame.

Flames are ideal for the production of nanomaterials because nanomaterials form far from equilibrium and the conditions of rapid reaction and rapid quenching of temperature in a flame are exactly the conditions needed to lock-in nanostructure during growth. We use spray-jet flames that consist of an aerosol (similar to hair spray) of a ceramic precursor solution that is ignited in a controlled supersonic jet for production of the nanosize powders needed in the Grätzel Cell. Through manipulation of the liquid feed to this flame we can control the chemical composition, size and structure of the resulting nanosize powder, optimizing it for Grätzel Cells. This work overlaps with a project to produce Solar Cells indigenously in sub-Saharan Africa funded by USAID.