Chemical and Materials Engineering
COLLEGE OF ENGINEERING

SUMMER RESEARCH OPPORTUNITIES
FOR UNDERGRADUATE WOMEN

APLICATION DEADLINE: March 1, 2006

The Department of Chemical and Materials Engineering is pleased to offer the following research project for the summer of 2006. 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.

Advanced Ceramic Materials for High Temperature Coal Combustion

Professor Vadim V. Guliants
Department of Chemical and Materials Engineering
University of Cincinnati, Cincinnati, Ohio 45221-0012
Tel. (513)556-0203

Fax. (513)556-3473

Email: vguliant@alpha.che.uc.edu; http://alpha.che.uc.edu/matcat

Further improvement of the thermal efficiency of steam cycle power plants is currently achieved by increasing the steam temperature and pressure. Increased combustion temperatures also result in more efficient coal use and environmentally friendly process characterized by reduced greenhouse gas emissions (~20% less CO_2), more complete SO_x and NO_x removal (~99%), as well as cleaner and more marketable coal combustion byproducts, such as fly ash. However, the main challenge limiting the application of higher combustion temperatures is severe fireside corrosion of boiler construction materials by molten alkali-iron-trisulfates and coal slag and their steam oxidation in the presence of SO_x, CO_2, etc.

The research in Prof. Guliants's laboratory is aimed at engineering new ceramic niobates and tantalates possessing the pyrochlore, fluorite and other crystal structures (Ln_3MO_7, where Ln = rare earth, Y or Sc; M = Nb or Ta). These materials are particularly promising as protective coatings in aggressive environments at high temperature in view of their superior mechanical strength, extremely high melting points (>3900^oF) and expected high corrosion resistance. The proposed summer REWU program will involve fabrication of new proof-of-concept Ln_3MO_7 coatings and characterization of their mechanical strength, thermal expansion behavior and corrosion resistance under simulated and real-life corrosive environment inside the University of Cincinnati power plant.