Gerhardt Completes Sabbatical at CNMS/ORNL

Professor Rosario Gerhardt spent the last academic year working at the Center for Nanophase Materials Sciences (CNMS) at Oak Ridge National Labs in Oak Ridge, TN. While there she worked with the Nanocharacterization Group using state-of-the-art atomic force microscopes. Her knowledge of impedance spectroscopy* contributed to the development of a user facility to measure the electrical response of materials as a function of frequency and location at the nanoscale. Professor Gerhardt wrote the software necessary to interface the impedance analyzer and the scanning probe microscopes as well as designed the hardware needed to make the measurements a reality. She also generated analysis software that helps the user convert the data into electrical resistivity, electrical conductivity, dielectric constant and dielectric loss as well as a few other functions and plot two, three and four-dimensional graphs that connect the topography with the electrical parameters. This software is designed to help the user determine whether an experiment is yielding the desired results. While she will continue to work with the CNMS staff to improve the different options, the new facility will become part of the CNMS general user facilities. She hopes to eventually set up a similar facility at Georgia Tech.

At CNMS Professor Gerhardt worked with the Functional Nanomaterials group to help design new transparent electrodes for solar cells and establish an impedance spectroscopy measurement facility for optoelectronic materials. She also interfaced with the Nanofabrication group for designing standard samples for nanocharacterization. Dr. Gerhardt stated that 'getting her hands dirty and spending countless hours in the lab' helped her appreciate the time and effort students invest generating their research results. She stated it had been many years since she was able to spend several hours a day in the lab and that although she enjoyed it she was delighted to be back guiding the work of her students rather than doing the experiments herself!

While the overall goal of her research continues to be the identification of structure-processing-property relationships in all classes of materials, Professor Gerhardt believes that her experiences at the CNMS/ORNL opened up several new exciting areas of research for her group.

Gerhardt's research group, consisting of 7-8 graduate students, a post-doc and visiting scientist, and 3-4 undergraduate researchers, did a commendable job of keeping up their activity level with her long distance supervision. Several students have had the opportunity to visit ORNL and conduct experiments using new state-of-the-art equipment. Dr. Gerhardt has applied for additional user projects that will allow her students continued access to the extensive user facilities at ORNL via the CNMS, SHaRE and SNS/HFIR programs.

A primary advantage of working with the National Labs Research staff is that one can rely on their expertise in a given area and acquire needed data quickly. Georgia Tech is fortunate to have such a good working relationship with this DOE funded research center and to have it within a few hours from the campus.

*Impedance spectroscopy is a technique that is useful for characterizing the AC electrical properties of materials and it is especially well suited to study all types of interfaces. The method can be used with all classes of materials: ceramics, polymers, metals, composites, biomaterials, etc.

Professor Rosario Gerhardt pictured with Ricky Whelchel (undergraduate student) who received the "Best Presentation" award at the 2008 Bodycote International competition.

Undergraduate Wins International Bodycote Competition

Ricky Whelchel came to Georgia Tech in Fall 2004 and quickly distinguished himself academically maintaining nearly a 4.0 GPA all four years until his graduation in May 2008.

In the fall of 2006, Ricky joined the Gerhardt research group to assist then graduate student, V. Siva Kumar G. Kelekanjeri, with some sample polishing but was given the task to relate the samples hardness to their corresponding electrical resistivity as an undergraduate research project. The materials being studied were a series of nickel base superalloys that are normally used in gas turbine engine components. These materials are known as precipitation hardened alloys because their microstructures consist of a dispersion of nanosize precipitates (referred to as gamma prime) dispersed inside mostly Ni-rich matrix grains. It is these precipitates that impart the high temperature strength to these alloys and their size and distribution can determine their mechanical properties during service. Since one of the goals of Professor Gerhardt's research is to use electrically-based techniques as a non-destructive method for microstructural characterization, Ricky's undergraduate research project was to provide a very important link between the mechanical properties and the electrical response. Ricky's excellent progress on his research prompted Dr. Gerhardt to nominate him for participation in the 2008 Bodycote International Competition. His abstract was chosen as one of 25 semifinalists from around the world, after which he wrote a full length paper. Shortly after he was informed that he had been chosen as one of seven finalists and he was the only US representative! Ricky delivered his presentation "Mechanical and Electrical Characterization in Age Hardened Waspaloy Microstructures," in Manchester, England in April 2008 where he was awarded the best presentation prize. He received a $3000 stipend and a Bodycote trophy. His last undergraduate semester was funded by a Georgia Tech PURA award.

Ricky is continuing his research with Professor Gerhardt as a Ph.D. student funded by a U.S. Department of Energy grant. He has made substantial progress on characterizing the size distribution of the gamma prime precipitates present in his alloys. To do that he is carrying out small angle scattering experiments at the Advanced Photon Source at Argonne National Labs, and at the HFIR Neutron Reactor at Oak Ridge National Labs. We are proud of Ricky and look forward to watching his research progress in the coming years.

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