

Traveling Time – Tenure-a-coming!



Counterclockwise: Eiffel tower, Roman coliseum, Bure spent fuel geological repository (500m underground, I am third from the left), Parthenon (Athens), AREVA Chalon big component manufacturing facility (I am second from the right, we are in front of a steam generator), Normandie beaches, Bure nuclear spent fuel geological disposal site.

Dr. Castaño's Group Report:

This last academic year has been a whirlwind of activity and varied successes in our Nuclear Engineering Department. Our department is easily experiencing the fastest growth in a long time. Our successes include getting our 7th faculty member (Dr. Liu), our best funding ever (grants from NRC, Darpa, Exelon, AREVA), and our highest enrollment ever in both our graduate and undergraduate programs. All this happens despite the difficult economic times the country is

experiencing and the deep budget cuts to public education at the state level. We are doing rather well in attracting external funding to our programs, and are strengthening our department's infrastructures and have many interesting plans for the years to come including increasing the power of MSTR, expanding the reactor building, acquiring a gamma source for material experiments, acquiring a ion accelerator, and more. All this flurry of activity is improving our ability to offer highly relevant nuclear engineering degrees that industry, government, and other graduate schools highly value.

By the way, congratulations are due to my last three graduate students to obtain their master's degrees. Brad Richardson is working for Transware International near Chicago analyzing and designing shielding containers. Jason Pleitt is working for Entergy in Mississippi as a Nuclear Safety Analysis Engineer, and Vivek Rao has been admitted as a PhD student in another academic unit (environmental engineering) in Missouri S&T. Jessika and Chrystian are still continuing to pursue their PhD's in my group, and our group might be hiring soon a third PhD candidate between this year and next. Actually Robert Zedric applied for and obtained a Fellowship from the South Carolina Universities Research and Education Foundation (SCUREF). This is also a first for our department, since only last semester I applied for our university to be considered among the institutions' that could apply for such fellowships and also grants on Nuclear Forensics, and Non-Proliferation research. Robert is now deciding if he will pursue his fellowship in Missouri S&T, MIT, Mizzou, and a few other candidate schools. The department also was the beneficiary of NRC fellowships and I hope we can hire a student to pursue his fellowship in the area of nuclear materials. Finally, last month I was informed that NRC was reviewing compliance (a first step) to give my group a Curriculum Development Grant on Corrosion of Nuclear Materials. This is a welcome development, and hopefully this will strengthen our curriculum in the area of Plant Life Management (PLiM), which is related to understanding and mitigating corrosion and degradation in our ageing nuclear power plant fleet.

As the title of this article implies, this was an interesting year from the perspective of traveling and there were some rather unique opportunities to travel and professional development I want to share with you. Last Fall Jessika and I made a poster presentation in the Missouri Nanofrontiers Meeting in Springfield, MO, and we won fifth prize. In the ANS Winter Meeting in Washington DC, Chrystian Posada, Edwin Grant (co-advisee), and Brad Richardson, presented four oral presentations related to our nuclear reactor (MSTR) modeling and validation as well as simulation work in the flat panel X-Ray source. By the way, Edwin and Chrystian won also 1st and 2nd place Graduate Research Showcase that recognize innovative research conducted at Missouri S&T. I am very proud of my very hard working graduate students. This is one of the joys of being a professor.

On the spring I was invited to judge the Nuclear Energy University Program grants in Washington, DC. Besides seeing the Japanese cherry trees blossom, it was a great opportunity to learn about "grantmanship" (grant writing ability), and to see what other programs across the US (57 grant applications in total) are doing to improve their programs (BTW, we are in good shape!).

I was also specially invited (expenses paid) to a UO₂ and MOX Fuel Performance Seminar in Idaho Falls, ID in May 2012. This was an excellent overview of the behavior of different nuclear fuel forms under evaluation. The information gather in this seminar will help our material research initiatives as well as enrich our course on nuclear materials (NE-341). The same week the fuel workshop was offered there was also another conference: The IAEA Third International Conference on Nuclear Power Plant Life Management for Long Term Operation (PLiM) in Salt Lake City, so I killed two birds with one stone. This was also an outstanding conference with ample participation from utilities all around the world. We received a firsthand account of the

Fukushima accident, and also of what problems ail other nuclear facilities in Europe, Russia, Japan, Korea, and others. It was a great learning experience. I have all the presentations and plan to incorporate some of this information in the nuclear materials class.

In the summer I was invited (expenses paid again) to the Modeling Energy and Validation School carried out in both Idaho National Laboratory and Oak Ridge National Laboratory. The school was outstanding, both in the scope as well as the quality of the participants. The participants were mostly professors, postdocs, and PhD level students from the US and abroad. It was very nice visiting back both INL and Oak Ridge for a week each and learning about their programs and unique facilities. I spent a year working in ORNL for my PhD degree.

To close my traveling this year, I together with eleven other professors were selected by the French Section of the American Nuclear Society to the Tour of French Nuclear Facilities for US Professors of Nuclear Engineering. This is an outstanding opportunity to visit and know our French colleagues nuclear facilities. We visited: SAMARIS large scale seismic test facility in Saclay (near Paris), MELOX and ATALANTE (MOX fuel fabrication plant and hot lab research), the AREVA's Large LWR fabrication facilities near Chalon, France's geological repository under construction (ANDRA) near Bure, and finally La Hague reprocessing site and the newest nuclear power plant under construction nearby (Flamaville). I was most impressed by this trip, as our French colleagues have some facilities that are not available in the US, and seeing reactor pressure vessels, heads, and steam generators being welded, finished, and shipped was a new experience to me. Same as seeing MOX fuel pellets on the other side of a plexiglas window by the dozens as they are prepared and packed for the different customers (Japan at the time). The geological repository is under active construction (I brought back some rock samples), all in all a great experience. The only sad part is the feeling I developed that our own nuclear program in the US lacks the vibrancy of our French counterpart. We have a lot of impressive facilities, but when you visit some of our hot labs, or nuclear research labs it feels as if our best times were past, while the French labs have an industrial feel to it. They are working at breakneck pace to keep up with the demand. It was a good feeling to see a place where nuclear is a popular word and where they are doing more and newer things to keep with the developments.

Besides this ton of traveling and good news with graduates, grants, and projects, last semester we also offered the first Radiochemistry course in more than ten years in Missouri S&T. It was a popular course with 40 students registered and the NRC grant funding this initiative was extended for another 6 months so that we can finish building our radiochemistry lab (the glove box is finally in!).

From the research perspective, we manage to produce samarium, nickel, and palladium nanoparticles free floating and supported on carbon nanotubes. The computer simulations of the distributed X-Ray source and the construction of a prototype are ongoing, with the test facilities for field emission being built in Fulton 213 (spherical high vacuum chamber and high voltage supplies), and the development of specially designed neutron and gamma shielding was also successfully conducted. Dr. Ahlam Abdulghani from Bagdad University (Iraq) was visiting our laboratories for several months and she worked shoulder to shoulder with Jessika and Vivek to produce new nanomaterials. She is back to her country and we hope she can come back some time in the future and we plan to collaborate from the distance.

Another collaborator of our group is Prof. Henry Colorado, he is a professor of materials in a prestigious university in Colombia, but is currently obtaining another higher education degree in the University of California Los Angeles (UCLA). We have been working on developing new

high resilience shielding materials for gamma and neutrons. He has helping greatly Jason with his project.

By the way, I was not the only one traveling in our group. This summer many of my students were also traveling. Jessika was working for the summer in Idaho National Laboratory in a project related to hydrogen embrittlement in high temperature nuclear reactors, Chrystian is still in the Netherlands designing and building a field emission tester, Rob was in Sandia conducting research on non-proliferation, Adam was doing an internship in Argonne National Laboratory, and finally Blake has been doing an extended Co-op with the Fort Calhoun Nuclear Generating Station in Nebraska.

By the way, for those of you who do not know, professors have really long trial periods called “tenure-track”. They basically test us for 6 years to see if we are worth a darn! ☺. Next year by the time I write the next Newstron article I will be under tenure review. Basically they will decide if I am good enough to stay or I should be looking for greener pastures. We are evaluated in three basic criteria: Research (publications, students graduated, and money raised), Teaching (including teaching evaluation), and Service. I just wanted to share with you that my tenure application period is approaching. So, how am I doing? As far as I am concerned, so far, so good! This has been a great experience and I am still enjoying my time in Rolla. There is never enough time to do the “gazillion” things we are supposed to do. In Dr. Kumar words: “professors always live in negative time”. I think the key is taking our jobs philosophically and doing the best we can. Trying to keep stress at bay and enjoying the trip. In my personal assessment, our current seven mariners (faculty) are navigating the currents well, and our ship (our program) is definitively sailing happily along and prospering. I look forward to see discover and navigate new shores.

Dr. Ahlam Abdulghani: As a research Iraqi fellow visitor in USA I enjoyed working in the Nuclear Engineering Department at Missouri University S&T for the period of June 6th to October 20th with Dr. Castano, Jessika and Vivek on the production of nickel, vanadium, and platinum nanoparticles supported by carbon nanotubes. We irradiated solutions containing nanotubes, palladium, vanadium, and nickel salts with a ⁶⁰Co gamma source in the University of Illinois. We plan to use these nanoparticles in hydrogen storage and nanofluid applications. I presented this work in the poster session of MS&T 2011 conference in Columbus, Ohio on October 2011. I had the chance also to present a lecture about different chemical and physical methods for the reduction of metal ions to produce nanoparticles. We are writing a paper on the production of nickel nanoparticles deposited on multi-walled carbon nanotubes by gamma radiation, which is a new area of research. Working on this project gave me a chance to join radiation safety training courses and to learn different characterization techniques, such as STEM, TEM, and XPS. This experience has encouraged me to create a postgraduate research program in my department to use gamma rays to enhance other chemical reactions in applied science.



Prof. Henry Colorado: is finishing his PhD in Materials Science at UCLA with Prof Jenn-Ming Yang. He is currently working in new ceramic composite materials for structural applications and thermal shock conditions. He had won several awards. Some of the most recent include: SAMPE Student Leader Experience Award Winner (2012), 3rd place for best paper award at the 35th International Conference and Exposition on Advanced Ceramics and Composites (ICACC'11); Neutron Award Student Poster competition at Advanced Test Reactor National Scientific User Facility Users Week 2012-



Idaho National Laboratory; Research Aide at Argonne National Laboratory (2011); scholarships for training in nuclear materials science at several National Laboratories: LANL (2010), INL (2011) and ORNL (2012). Henry has a BS and MS in Mechanical Engineering from the National University of Colombia. Henry has a joint appointment as faculty at the University of Antioquia, Colombia.

Chrystian M. Posada: It has been a little more than a year since I obtained my MS degree in Nuclear Engineering. Since then I have been working on my PhD in Nuclear Engineering at Missouri S&T. During my master's project I designed and simulated a field emission based electron source to be used in a Flat Panel X-ray source. My PhD work includes the microfabrication and testing of the first prototype of the electron source of this flat panel x-ray source. As a result of the work in the Flat Panel X-ray source project, a total of three journal papers have been published in SPIE, JVST-B and ARI. Additionally, our results have been presented at several peer reviewed national conferences. I recently finished the construction of a state-of-the-art high vacuum system equipped with high voltage capabilities to perform the field emission experiments in our laboratory at Missouri S&T. Right now I am in the Netherlands working as a guest researcher. During this time in the Netherlands I have been gaining valuable practical experience on field emission measurements, electron sources characterization and their final applications. I hope to apply all this experience to my own experiments once I get back to Rolla. In summary, it has been a good year so far, and somehow the end of my PhD seems to be starting to get close.



Jessika Rojas: We have been studying hydrogen as an alternative source of energy (a project funded by the U of Missouri Research Board). During my master I worked on the synthesis and deposition of palladium nanoparticles on carbon nanotubes using gamma irradiation for hydrogen storage purposes, and also in the synthesis of nickel nanoparticles. The results have been presented in several conferences, TMS, MS&T, MO Nanofrontiers. Additionally, we wrote a chapter for the book *Radiation Synthesis of Materials and Compounds*, Taylor & Francis Group, to be released in early 2013. This area opened to me several options of research using radiation chemistry for the synthesis of some other type of nanoparticles with medical applications (Au, Re, Y). Thus, for my Ph.D., I am focusing on the synthesis of radioactive nanoparticles for cancer imaging and treatment using the same approach. Gamma radiation has the advantage of simple physicochemical conditions that lead to homogeneous reduction and nucleation of the metallic nanoparticles.



Rob Zedric: I'm a junior from Decatur, IL. Apart from classes, I keep myself busy on the Rolla Rural Fire Department, where I'm a firefighter and an EMT. In my free time, I enjoy shooting guns, snowboarding, and building electronics. Though I came to Rolla for mining, I switched to nuclear engineering when I realized I didn't like rocks. I wanted something more energetic and challenging, and I hoped to find it in this rare field. Soon after I met Dr. Castano in his Intro to Nuclear class, he told me he was founding a nuclear laboratory on campus and wanted student workers to help. I thought it would be a great opportunity to get involved in research, so I signed up. Right away, he gave me experiments to work on and a laboratory to work in. I am currently evaluating a technique to measure radium concentrations in ground water, but will soon move on to designing a nuclear bar code to tag explosives (nuclear forensics).



Blake Bohn: I'm from Jackson Missouri, I transferred in from a small college to S&T for nuclear engineering. Normally I spend most of my time in Rolla doing homework or research. It can get very busy but I like learning about nuclear technology so it's very enjoyable. In my free time I like to shoot firearms, go caving, float down rivers, hiking, and collecting common radioactive materials/isotopes. My first nuclear class at Missouri S&T was NE105. That's where I met Dr. Castano. He was looking for research assistants for a radiochemistry initiative. I did not have much experience and knew I needed to learn more so I volunteered. I found out later that I would be helping set up a radiochemistry and nuclear forensics lab. I found out that we would need an alpha spectrometer. Dr. Usman's lab had an alpha spectrometer and I spent most of my time calibrating and setting up the equipment.



Adam Stensland: I am a senior in the Nuclear Engineering department from Edwardsville, IL. Dr. Castano is my advisor and I have been helping out with the Oxide Dispersion Strengthened (ODS) Steel project. I began working last summer (2011). During the summer I was working at Argonne National Laboratory as a student intern. I am ready to begin my work on campus again this fall. We now have more equipment and materials, so the project is progressing well.



Brian Seawright: I am a Nuclear Engineering senior from Chesterton, Indiana. I have been a part of the Nuclear Engineering since my freshman year. Dr. Castano has been my academic advisor for the past two years. And I have recently started assisting Dr. Castano with his Oxide Dispersion Strengthened (ODS) Steel project. In creation of shaping the fatigue test specimens, I have been repairing a temporary down friction stir welding (FSW) machine. The machines will give us more accurate fatigue test of the different materials.

