

Post-Tenure Hopes and Dreams.



Dr. Castaño's Group Report:

Another year of labor bring us into continuing research and new initiatives. I am happy to report that Dr. Ahmed Haidyrah graduated in the spring and is back in his country. His work on the study of fatigue mini-specimens for nuclear materials is first of a kind, and I hope we can find funding to continue this work. Also, a group of undergraduate students (Brian Mills, Kyle Acker, Joshua Burks, Jacob Luetzow, and Ethan Niehaus) produced for the first time ever radioactive gold nanoparticles. Such nanoparticles are useful for the treatment of several types of cancers. Maria Camila Garcia my MS student is currently exploring the parameter space of multiple irradiations and other variables. We have obtained excellent preliminary results. Now, we need to try harder than ever to get funding for her to continue her work as a PhD student.

This part year was the most fruitful ever in the number of Opportunities for Undergraduate Research Experiences (OURE) initiatives. Five different projects were pursued by undergraduate students including, creation of a plasma laboratory (Monica Gehrig), friction stir welding (Chandler Mills, Mitchell Smith, Charlie Moore, Michael Hall), bombardment of zirconium di-boride (ZrB_2) to simulate neutron damage (Steven Wessels), nanofluid study for erosion-corrosion of nuclear materials (Dan Watson), and radon synergetic interaction with electronic cigarettes (Eric Carlson). While not all projects achieved the dreamed stage of obtaining definite results, all of them contributed to prepare future graduate work and also gave the opportunity to undergraduate students at different levels (sophomores, juniors, and seniors) to experience the joys and frustrations of scientific research. These included experience the self-motivation required, literature searches, as well as design, construct, test, and often times (try to) fix equipment needed for research. It has been an interesting journey that has taken us by many fields related

to nuclear technology. Our group has explored fields as wide-ranging as nuclear medicine (nanoparticles for cancer treatment, lung cancer induced by radon), to design of new materials for radiation shielding (chemically bonded phosphate ceramics doped for gamma and neutron shields), nuclear material testing (metal fatigue, irradiation of ultra-high temperature ceramics, erosion-corrosion, friction stir welding), and various plasma and vacuum technology.

We have hired our 8th faculty member. Dr. Joseph Graham an expert on irradiation of nuclear materials is joining us from the University of Tennessee. I was honored to serve as chair of the selection committee and hope that our work on nuclear materials under extreme environments will be significantly strengthened by his contribution. He already helped us plan and execute the first ZrB₂ ion irradiation, and the samples are ready and waiting for his arrival.

In summary, this is another exciting year of research, teaching, and service. We keep working long and hard to raise research money to expand our nuclear reactor, and pursue many areas of research. It is a difficult endeavor to convince the funding agencies to fund our initiatives, much more in these lean fiscal times. Of course little could be done without the help of all my collaborators and students (not counting S&T faculty):

Prof. Henry Colorado: Dr. Colorado is a professor of Mechanical Engineering and Materials at the University of Antioquia (Colombia). We continue our cooperation working on ceramic materials for structural and shielding applications that can resist fire and shock conditions possibly to be encountered in transportation accidents. We have also published a book chapter on the application of chemically bonded phosphate ceramics for nuclear waste applications.



Ahmed Haidyrah: Ahmed graduated with his PhD and is back in his beloved country. His research produced positive results for the analysis of bending fatigue mini-specimens. His work on fatigue of mini “Krouse specimens” has been submitted for publication to several magazines.



Maria Camila Garcia: Maria Camila is currently pursuing her MS by making radioactive gold nanoparticles by gamma and neutron radiation. This technique has the advantage of producing well-characterized radioactive gold nanoparticles in a single step reducing the complexity and cost of producing specialty drugs for cancer treatment.



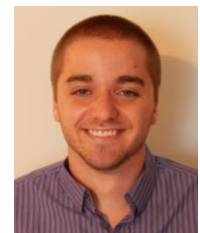
Daniel Watson: Dan has been working for Dr. Castaño for two years in Corrosion of Nuclear Materials (creating a learning module for NE341: Nuclear Materials funded by the NRC). We designed a new set of lab practices that will help future nuclear engineers understand the importance of corrosion. Corrosion is of major importance to nuclear engineers, as we need our materials to maintain their properties within safety margins. Dan graduated in December 2014.



Chandler Mills: Chandler designed and presented an OURE proposal on friction stir welding before he graduated from the nuclear engineering program at S&T. He is currently a graduate student at Missouri S&T in a different research group.



Steven Wessels: Steven designed and performed an ion irradiation of zirconium di-boride (ultra-high temperature ceramic) at the University of Tennessee as part of his OURE work. Missouri S&T is a leader in the research of ZrB_2 and very little information is known on this promising ceramic that could compete with SiC as a future material for advanced nuclear reactors both fission and fusion.



Monica Gehrig: Monica conducted an OURE on the establishment of a plasma laboratory in S&T. She worked on developing practices that can be used for a plasma lab that will be available to S&T students in the future including vacuum technology, DC glow discharge, and others.



Eric Carlson: Eric conducted an OURE study on the synergetic health effects of radon and electronic cigarette vapors. As the advent of electronic cigarettes is fairly recent, much research is yet to be conducted on its health effects. A well-established phenomenon involving classical cigarette smoke is that radon gas can become electrostatically bonded to the smoke particulates, leading to a significant increase of lung cancer. We seek to determine whether or not this phenomenon also occurs with droplets from electronic cigarettes.



Mitchell Smith: Mitchell conducted an OURE on friction stir welding. He successfully welded several pieces and learned all the intricacies of operating this complex piece of equipment. Our limitation to further working with the equipment was due to the lack of more advanced tools suitable for steels or higher temperature alloys. In a future work, preheating of the samples and the use of ultra-high temperature tools will be attempted.



Charles Moore: Charlie helped Mitchell with his OURE project and doing the dirty work of cleaning and preparing a place to work besides assisting with the friction stir welding itself. Working in a group was much better than individually and better results were obtained due to the diligence of the team.



Michael Hall: Michael also helped Mitchell with his OURE project, and preparing a place to work in friction stir welding. His knowledge of welding techniques as well as Mitchell helped to carry the project forward.