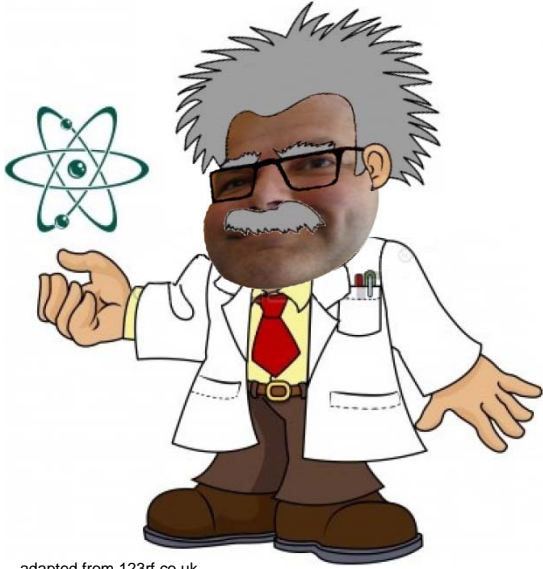


## Tenure Time! New Dreams for the Future.



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### **Dr. Castaño's Group Report:**

As I explained last year, the job of a tenure-track professor has a rather long probationary period of six years. At the end of six years the university makes a firm decision to either retain the faculty member or dismiss it (grant tenure or not). I am happy to report that after many months of evaluation I was granted tenure. My tenure letter is succinct enough to quote here in its entirety: "We are pleased to inform you that you have been granted tenure and promoted to associate professor effective September 1, 2014. We extend our personal congratulations to you in your accomplishments and look forward to your continued strong contributions to Missouri S&T in teaching, research, and service." Thus, here I am, and I shall remain as your newest associate professor. I am joining the associate professor rank together with Dr Mueller, Dr Usman, and Dr Lee. Uhu!

There are plenty of exciting news together with this promotion. First, while I have had so far 5 students obtain their Masters in nuclear engineering under my supervision, for the first time ever 2 students have obtained their Doctoral degrees with me. I am very proud of them. When we professors produce PhD students we strive to produce peers. As such, I am happy to report that Dr. Jessika Rojas is now herself a tenure-track professor in the Virginia Commonwealth University in Richmond, VA and Dr. Chrystian Posada is a postdoc researcher at Argonne

National Laboratory. I will be looking forward to see their development as professionals in years to come.

The second of the great news is that as part of the effort from our campus to grow according to research trends, we have started looking for a new professor of nuclear engineering. Therefore if all goes well, next year we should be celebrating our new hire. This position will be created to reinforce our work in the strategically important area of structural materials for extreme environments. As such, the new professor will work with other professors in ceramics, materials, chemistry, solid state physics, and mechanical and aerospace engineering. Needless to say that having an eight faculty member is much needed given the impressive growth of our program in recent years, which is still continuing.

Talking about growth, bring us to the next great news. I have just hired a new graduate student. Her name is Maria C. Garcia. She should be arriving in mid-august and will start right away adapting to our work here. She will join Ahmed Haidyrah in my group. Hopefully next year one of my undergraduates (Dan Watson) will also join my research group as a new student. One of my previous undergraduate students Chandler Mills is also joining Missouri S&T, but under the supervision of one of my colleagues. It is joyful to see our department continuing to grow our research work both with in-house and external graduate students.

Talking about research, now that my tenure has been granted, I look forward to deepening my research and hopefully make a deeper impact in my areas of interest. Those following my work in the past know that I have done some work on production of nanoparticles with radiation and laser energy. Our newest initiative is to truly mass-produce nanoparticles using water jet technology developed at Missouri S&T. This is an interesting initiative that plays well to the strengths of our Mining and Nuclear Engineering department. Dr Xin Liu, Dr Shoaib Usman, Dr Joshua Schlegel from nuclear, as well as Dr. Greg Galecky and Dr. Lana Alagha from mining are part of this initiative. Such nanoparticles produced inexpensively can be used to dramatically change the properties of fluids (nanofluids) as well as for its electrocatalytic properties. Don't be fooled by the esoteric name. I am hoping that we can functionalize the nanoparticles to eventually produce liquid hydrocarbons starting with little more than electricity (hopefully from nuclear), CO<sub>2</sub>, and water. The key to achieve this dream is to perfect what is called one-carbon chemistry. At present it is done under high temperatures and pressures (Fischer-Tropsch process

and variants) making the process expensive and not particularly environmentally friendly. Dr. Joseph Smith from the Energy Research and Development Center is already experimenting with this approach to solve our energetic crisis as well as incoming climatic crisis if we keep business as usual.

These of course are just some of the things we do and research. There are other initiatives we maintain although it is hard to find funding for some of them to keep pace. Friction stir welding (FSW) is alive and well. Our collaborators in Brazil has FSW'ed HT-9 a special steel with potential application for radiation resistant materials. Ahmed is making steady progress studying fatigue of subsize samples. Our work with shielding of special formulations of chemically bonded phosphate ceramics (CBPCs) is also going on. We are studying the interaction of radon with new electronic cigarettes, and a few others.

In summary, join me for another exciting year of teaching, research, and service keeping the dream alive at Missouri S&T!

As it is tradition now, here are the group of collaborators (not including S&T faculty) that helped keep things moving along last year, as well as some new arrivals.

**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.



**Hazim H. Abdulkadhun:** Hazim is a PhD student from the Mechanical Engineering Department, College of Engineering at Baghdad University, in Baghdad-Iraq. He has extensive experience with mechanical systems. He has finished repairing, reprogramming, and testing Dr. Castano's friction stir welding machine. Thanks to his excellent work, we plan to test the friction



stir welding properties of ferritic-martensitic as well as ODS steels of interest to the nuclear industry. Initial samples have already been welded in Brazil with our collaborators there. At present, we are trying to find funding to continue this initiative.

**Ahmed Haidyrah:** Ahmed is a sponsored student from King Abdul-Aziz University for Science and Technology in Saudi Arabia. He is pursuing a PhD at the Nuclear Engineering Program. His current research is to evaluate the suitability of a bending fatigue technique. This technique is used to determine the capability of the nuclear material to resist cracks and other mechanical failures due to repeated use and strains. Because of limited space in nuclear test reactors (such as ATR) to irradiate full size fatigue specimens in sufficient quantities. The mini-specimens of special shapes are called “Krouse specimens”. We plan to use Stainless steel 304L, 316L, HT-9 and oxide dispersion strengthen (ODS) steels address irradiation issues in nuclear materials. A new bending fatigue machine was created for mini-specimens to study the fatigue by repeatedly bending the specimens slightly until they fail. We have tested stainless steel 304L to test the technique and have also used ABAQUS to determine the maximum stress for a given deflection.



**Maria Camila Garcia:** Maria Camila is a recently graduated chemical engineer from the Nacional University of Colombia where she worked doing research in electrochemical engineering for 3 years. Her research topic was solid oxide fuel cells (SOFCs), specifically the construction and characterization of electrocatalytic material to be used at intermediate temperatures. Her work began with the synthesis of ceramics oxides for the construction of electrocatalysts and progressed into a general interest on working with materials: synthesis, conformation, assembly, characterizations, including manufacturing of nanoparticles. In her own words: "I have the great opportunity to work with Dr. Castano to do my master in Nuclear Engineering, I hope to give my best and to learn of everyone of my lab mates. It is difficult to leave home, but our steps should go forward and we should grow up! Besides like someone says in my home "pa' atrás ni pa' coger impulso".



**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 is planning to graduate in December 2014 and hopefully he will join our group as our newest graduate student.



**Chandler Mills:** Chandler just graduated nuclear engineering program at S & T. He was involved in corrosion research and creation of practices for the corrosion module for NE-341. While he continues to pursue other initiatives, we expect he will join us as a graduate student at Missouri S&T in the near future.



**Steven Wessels:** Steven is doing some preliminary research on the properties of zirconium diboride (ultra high temperature ceramic) under irradiation. 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. Steven plans to remain at Missouri S&T for graduate school.



**Monica Gehrig:** Monica is a sophomore in the nuclear engineering program at S&T. She has started doing research about plasma under the advisory of Dr. Castano and Dr. Rovey. Over the course of the year, she will be developing practices that can be used for a plasma lab that will be available to S&T students in the future.



**Eric Carlson:** Eric has been working for Dr. Liu and I, analyzing the synergistic health effects of radon and electronic cigarette vapor. 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.  
Eric plans to continue his education at Missouri S&T for graduate school.