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Editorial

Advanced functional and biological materials: a memorial issue dedicated to Professor Joanna McKittrick



Professor Joanna McKittrick joined the Department of Applied Mechanics and Engineering Science at the University of California, San Diego, in 1988, immediately after receiving her Ph.D. in Materials Science and Engineering from MIT (with a concentration in ceramic science). She was the second female professor to join the department and established herself, from the start, as a dedicated and talented researcher, pursuing rapid solidification of ceramic superconductors (Fig. 1).

Prior to attending MIT, she received a BS in Mechanical Engineering from the University of Colorado, Boulder, completed in 1979, and an MS degree from Northwestern University completed in 1980. As a graduate student, she already displayed the qualities which would bring her prominence in materials science. Her doctoral advisor, Professor Gretchen Kalonji, remembers her fondly and her words sum up her unique qualities:

“Joanna did her PhD with me at MIT on rapid solidification of ceramics, with a particular focus on oxide superconductors. In fact, Joanna was the first PhD student I agreed to take on and it still puts a huge smile on my face to recall her initial exploratory visit to MIT to choose an advisor. Joanna, through her brilliance and initiative, had been successful in obtaining her own funding for her graduate studies, so, logically, SHE was interviewing US, to find out which one she would agree to work with. Of course, I was delighted by her self-confidence, curiosity, and, even in that first encounter, with her inimitable and biting sense of humor. Of course, most of my more senior colleagues were quite taken aback by having to answer probing questions from a potential advisee. That was Joanna, though. Courage was one of her most admirable traits, and she was not about to be intimidated by anyone. Joanna was an extraordinarily intellectually independent doctoral student; in fact, perhaps she spoiled me for life in that regard. I learned later in my career, that in fact most students really want to be told what to do step-by-step in the course of their research. Joanna was delightfully surprising, always coming up with new ideas and directions – a person with whom it was a true joy to work.”

Professor Marc Meyers, her close colleague and Editor-in-Chief of JMRT, adds this:

“I met Joanna in 1988, when I was still at New Mexico Tech and before I joined UC San Diego. She was finishing her Ph. D. at MIT and interviewed with us. I immediately saw her talent and potential and sent her resume to Professor Sia Nemat Nasser, who was at that time putting together the framework of a materials program at UC San Diego. So, we arrived in La Jolla at the same time. I can still see her walking into our apartment in La Jolla del Sol with Karen Kavanagh, another hire. Joanna, Karen, and Janet Talbot would form a strong bond that lasted until the end. This was a gift for her, surrounded as she was by a male-dominated academic environment. She tirelessly worked on her spin casting machine, producing rapidly solidified ceramics, while I concentrated on impact-related topics. So, our close collaboration would have to wait twenty years, until we embarked on the wonderful adventure of exploring biological and bioinspired materials. She suggested that we share our laboratories, and I reluctantly agreed, being accustomed to the intensely territorial academic environment. This worked surprisingly well, our students sharing equipment, ideas, and enhancing our close collaboration. I realized the incredible attention she gave to writing and the ability that she had to compete with the “crème de la crème” of National Science Foundation proposals. She also had an uncanny ability to go to the heart of problems, and her sardonic comments often carried the truth that many appreciated and some abhorred. Our collaboration would have continued unabated were it not for her tragic loss. My consolation is that her current students are continuing her legacy.”

Professor McKittrick’s main research interests included biological and bioinspired materials science, especially the relationship between their structure and mechanical behavior. In particular, she investigated the structure and property relationships in mineralized and non-mineralized natural materials such as bone, teeth, osteoderms, feathers, quills, and seahorse tails; and determined their failure and deformation modes. A topic close to her heart was bone demineralization and deproteination. These structures have inspired the fabrication of bone and abalone nacre-like



Fig. 1 – Professor Joanna McKittrick.

composite materials and the development of a seahorse tail-inspired robotic arm.

Additionally, Professor McKittrick was an expert on the luminescence properties of materials, with a particular interest in rare-earth doped oxides. Her work on luminescent materials involved developing phosphors for heads-up displays, flat panel displays, and scintillators for drug delivery systems. More recently, her work focused on the synthesis and development of phosphors for LED-based solid-state lighting. She spent a most productive year at the National Science Foundation as a Program Manager; this stay had a very positive effect on her career and helped her in broadening her research perspectives and identifying important areas.

Professor McKittrick's research received international research accolades and inspired the imagination through widespread popular news coverage, including articles in venues such as *Popular Science*, *Science News*, *Tech Times*, *Nature Discovery*, and the *Smithsonian* magazine. She served as Editor of the *Journal of the American Ceramic Society*, Associate Editor for the *Journal of Biomaterials Applications*, and Associate Editor for *Materials Characterization and Ceramics*. Among many other honors, Professor McKittrick was the recipient of the 2017 UC San Diego Faculty Research Lecturer Award, given in honor of her significant research contributions.

Prior to her passing, Professor McKittrick was greatly inspired throughout her life by her mother, who instilled in

her the value of striving for the best, never giving up, and reaching ambitious goals. These ideals were passed on to her students through her many mentorship roles. In particular, Professor McKittrick was a great supporter of women in science and engineering and was research advisor for many undergraduate students through the years, inspiring them to become better versions of themselves.

She will be deeply missed by her family, colleagues, friends, and former students. Professor McKittrick is survived by her sisters Lisa Cleveland and Marcia Hodulik, her niece and nephews Spencer Cleveland, Nichelle Hodulik, Reid Cleveland, and Evan Hodulik.

Professor McKittrick's academic impact and legacy will be carried on by her Ph.D. students, Eric J. Bosze, Po-Yu Chen, Jonathan Huai-Tse Tao, Ahmed Mohamed El Desouky, Ekaterina Evdokimenko, Wei Li, Jinkyu Han, Jae Ik Choi, Michael M. Porter, Steven E. Naleway, Michael B. Frank, Wei Huang, Geuntak Lee, Frances Y. Su, Jae-Young Jung, and Jungmin Ha. During her academic career, Professor McKittrick's work was published in more than 130 peer-reviewed journal articles, which have laid the framework for an immeasurable scientific impact.

This volume, dedicated in her honor, contains articles by her current students, former students and colleagues. They are divided into two areas which correspond to the research activities of Professor McKittrick: biological and bioinspired materials, and luminescence.

Declaration of Competing Interest

The authors of this manuscript, declare no competing interests

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