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IN MEMORIAM

John E. Morral (1939–2020)

John E. Morral

Professor John Morral passed away unexpectedly a few days before Christmas on December 21, 2020. Professor Morral started his professional life in materials science when he studied metallurgical engineering at The Ohio State University. After receiving his Master of Science degree, he proceeded with his doctoral work at the Massachusetts Institute of Technology, receiving his doctoral degree in 1969. After a short time at the University of Illinois, he joined the University of Connecticut in 1971. There, he became full professor and, ultimately, department chair until his retirement in 2003. Shortly thereafter, he was recruited by The Ohio State University as chair of the Materials Science and Engineering Department where he remained until his retirement in 2012. After becoming professor emeritus, he continued to contribute to materials science and engineering by authoring articles and by serving as editor-in-chief of the *Journal of Phase Equilibria and Diffusion*.

Professor Morral loved his work. His doctoral advisor, Professor John Cahn, said about Professor Morral that as a student he was not deterred by tough problems; he would take his time and solve the problem. This tenaciousness resulted in many significant contributions to the understanding of multicomponent phase diagrams and diffusion processes. He introduced the concepts of zero-phase fraction (ZPF) and single-phase boundary lines (SPB) in his work on phase fraction charts. These concepts are today staples in the teaching of phase diagrams, and the ZPF concept is an underlying basis in many general phase diagram calculation programs.

The impact of Professor Morral's work on the understanding of diffusion processes is even more profound. Applying the error function solution for binary diffusion couples to interdiffusion in ternary 2-phase alloys resulted in the discovery of "zigzag diffusion paths." He also found that only three different types of planar boundaries can occur in multiphase diffusion couples under local equilibrium conditions. Both were later confirmed in experimental investigations and simulations. Professor Morral's tenaciousness is probably best illustrated by his investigations of so-called "horns," sharp discontinuities in the zigzag diffusion path, that can form at type zero-boundaries in two-phase diffusion couples. The formation of double horns and single horns was observed in simulations using commercial finite difference software, while only single horns were observed in phase field simulations in two-

phase diffusion couples with the same matrix phase. Using a different implementation of finite difference code, Professor Morral and his co-authors showed that these double horns were an artifact of the commercial software implementation, which was subsequently corrected. His body of work made a significant contribution to the interpretation of multicomponent diffusion paths, such as his 11 additional theorems on ternary diffusion paths.

Professor Morral's dedication to science was not limited to his own research and students, it also included service to the scientific community. After serving as deputy editor of the *Journal of Phase Equilibria and Diffusion* (JPED), he became the editor-in-chief in 2012. One of his goals was to serve authors and readers in the best way possible. He worked tirelessly to maintain the journal quality and sought out essential papers on phase equilibria, thermodynamics, and diffusion and their application to industrial problems and articles that stretch the boundaries of the known. His efforts were rewarded by more than doubling the impact factor during his tenure. Professor Morral's careful work and guidance as editor-in-chief will be remembered by the associate editors, ASM staff of JPED, and the members of the ASM Alloy Phase Diagram Committee, the advisory committee for JPED.

Professor Morral was a regular participant at the NIST Diffusion Workshop series since its inception in 2003. He always challenged the participants to find new approaches to multicomponent diffusion, and with his teaching expertise, his explanations of the problems and outline of the possible solutions were always clear. There is no doubt that his participation greatly contributed to the success of the workshop series.

Professor Morral was so much more than a great scientist and dedicated editor. His philosophical thoughts are expressed in the editorials he wrote for JPED and he also liked to compose small lyrics, such as the one printed in his obituary. He was cherished for his kindness, generosity, and positive attitude. This is reflected in his 2015 editorial in JPED on "Awards and the Pursuit of Happiness" where he expressed his joy that others had received awards. The community acknowledged and celebrated his scientific work by awarding him the prestigious J. Willard Gibbs Phase Equilibria Award by ASM International in 2018. The community has lost a great man, mentor, and friend, and his passing has left us with a great void.

The many testimonials to Professor Morral's great personality can be found at the Tribute Wall at https://www.schoedinger.com/obituaries/John-Morral/.

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