Materials Science and Engineering Department

Fall Seminar Series

Stopping Crystal Growth in its Tracks: Molecular Therapies for Pathological Crystallization

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The crystal growth of conventional materials like silicon has been refined for decades and has led to textbook crystal growth models. Confidence in these models quickly evaporates when considering complex inorganic solids and molecular crystals, however, despite the importance of these materials to technology, biology, and human health. In particular, many crystalline materials are associated with diseases, from malaria to kidney stones. This presentation will illustrate the beauty and complexity of crystal growth, through mechanisms often hidden and deceptive, in pathological molecular crystals, including kidney stones as well as "xenostones" that form as a consequence of active pharmaceutical ingredients that form crystals in renal spaces. Armed with an understanding of some crystal physics and crystal surface structure at the molecular level, crystal growth inhibitors can be designed that bind to specific crystal sites and prevent the formation of pathological crystals, suggesting a pathway to therapies for crystal-based diseases in general. These observations also reveal the complexity of dissymmetric surfaces of organic crystals, which stems from their inherent low molecular and crystal symmetry.

Michael D. Ward received his undergraduate degree in Chemistry from the William Paterson College of New Jersey in 1977 and his Ph.D. degree at Princeton University in 1981. He was a Welch postdoctoral fellow at the University of Texas at Austin, between 1981 and 1982. He joined the research staff at Standard Oil of Ohio in Cleveland in 1982, and in 1984 he became a member of the research staff at the Dupont Central Research and Development Laboratories in Wilmington, Delaware. Ward joined the faculty of the Department of Chemical Engineering and Materials Science at the University of Minnesota in 1990, where he held a joint appointment in the Department of Chemistry. Ward was named a Distinguished McKnight University Professor in 1999, and he was the founding Director of the University of Minnesota Materials Research Science and Engineering Center (MRSEC) from 1998 – 2005. He moved to New York University in 2006 to create the Molecular Design Institute within the Department of Chemistry. Ward is the founding Director of NSF-supported NYU MRSEC, and served as its Director through 2017. He was appointed as a Silver Professor by NYU in 2008 and Chair of the Department of Chemistry in 2009, serving for six years. Ward also has served as an Editor for the ACS journal Chemistry of Materials since 1998. He is a Fellow of the Materials Research Society, the American Chemical Society, and the American Association for the Advancement of Science. He has published more than 240 peer-reviewed manuscripts in highly ranked journals and presented more than 200 invited seminars. His research interests span organic solid-state chemistry, crystal engineering, functional organic materials, crystallization, polymorphism, the role of biominerals in biomedicine and disease, organic epitaxy, and atomic force microscopy.

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