Smart and Programmable Sponges

from Basic Science to Implementation and Commercialization.

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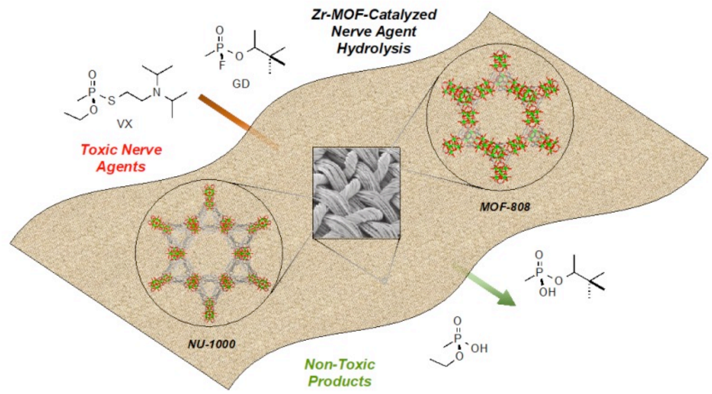

Abstract: As chemists and materials scientists, it is our duty to synthesize and utilize materials for a multitude of applications that promote the development of society and the well-being of its citizens. Since the inception of metal–organic frameworks (MOFs), researchers have proposed a variety of design strategies to rationally synthesize new MOF materials, studied their porosity and gas sorption performances, and integrated MOFs onto supports and into devices. MOFs are a class of porous, crystalline materials composed of metal-based nodes and organic ligands that self-assemble into multi-dimensional lattices. In contrast to conventional porous materials, an abundantly diverse set of molecular building blocks allows for the realization of MOFs with a broad range of properties. Efforts have explored the relevance of MOFs for applications including, but not limited to, heterogeneous catalysis, guest delivery, water capture, destruction of nerve agents, gas storage, and separation. For example, we have developed an extensive understanding of how the physical architecture and chemical properties of MOFs affect material performance in applications such as catalytic activity for chemical warfare agent detoxification. Recently, start-up companies have undertaken MOF commercialization within industrial sectors. ION-X™ is used in this talk as an example to show case the way NuMat Technologies is innovating at the intersection of molecular design and precision engineering, to build the products driving the industries of tomorrow.

Omar K. Farha a Charles E. and Emma H. Morrison Professor in Chemistry at Northwestern University, an Executive Editor for ACS Applied Materials & Interfaces and President of NuMat Technologies. His current research spans diverse areas of chemistry and materials science ranging from energy to defense-related challenges. Specifically, his research focuses on the rational design of metal-organic frameworks (MOFs) for applications sensing, catalysis, storage, separations, and water purification. His research accomplishments have been recognized by several awards and honors including a fellow of the European Academy of Sciences, a Fellow of the Academy of Arab Scientists, Kuwait Prize, Japanese Society of Coordination Chemistry "International award for creative work", the Royal Society of Chemistry "Environment, Sustainability and Energy Division Early Career" Award, the American Chemical Society "The Satinder Ahuja Award for Young Investigators in Separation Science" and "ACS ENFL Emerging Researcher Award", and an award established by the Department of Chemistry at Northwestern University in his honor: the *Omar Farha Award* for Research Leadership "awarded for stewardship, cooperation and leadership in the finest pursuit of research in chemistry" and given annually to an outstanding research scientist working in the department. Prof. Farha has more than 650 peer-reviewed publications, holds 17 patents, over 100,000 citations and h-index of 156 (Google Scholar), and has been named a "Highly Cited Researcher" from 2014 to 2023. Prof. Farha is the co-founder and president of NuMat Technologies, the first company to have commercialized an engineered system-level product enabled by Metal-Organic Framework Materials.