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COLLEGE OF ARTS & SCIENCES

Department of Chemistry

Brown and Williamson Series

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Chemistry Building, LL-16

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ACS Division of Fluorine Chemistry

Industrial Scale Fluorochemical Synthesis: Fundamentals of Liquid and Gas Phase Fluorination Catalysis for Halogen Exchange Chemistry in the Preparation of Low Global Warming Potential (GWP) Fluorocarbons

ABSTRACT: Fluorination catalysts, both homogeneous and heterogeneous, are vital process components in the preparation of Low-GWP fluorocarbons acquired through halogen exchange chemistry. Homogeneous catalysts are employed in liquid-phase halogen exchange reactions and are often based on chlorofluoro derivatives of Sb(V). Heterogeneous catalysts are used for gas-phase halogen exchange reactions and are most often based on high oxidation state oxide fluorides of transition metals such as Cr(III) and Cr(IV).There are many process factors that determine the performance, lifetime, and overall efficiency of a halogen exchange catalyst. Some of the most important factors include the method of catalyst preparation, activation, and re-activation, process pressure and temperature, molar ratio of exchange reactants and the presence of co-fed reactants for catalyst stabilization and longevity. Each of these process factors can greatly influence the economic viability of an industrial process.

In this talk, some important fundamental aspects of liquid and gas phase fluorination catalysis will be discussed with particular focus on the critical process steps affecting catalyst fluorination, activation, and longevity.

BIO: Robert (Bob) Syvret has a Ph.D. in main group fluorine chemistry from McMaster University with 30+ year industrial experience creating new molecules, developing new process technology, and commercializing a number of new high-value products. He has hands-on experience with new molecule synthesis for applications in electronics (fluorine etchants and deposition agents), pharmaceuticals (fluorinated steroids, nucleotides, and aromatics), agricultural (fluorinated herbicides, and pesticides), low-GWP refrigerants and foam expansion agents, fluorinated monomers and polymers, fluoro-surfactants, and inorganic fluorine compounds. During his career, Bob has provided technical leadership in activities including new molecule discovery, process development and optimization, scale up, plant support, hazards assessment and regulatory issues, analytical methods development, product stewardship, and safety testing. He was the technical leader on projects that delivered successful commercial products including Selectfluor® (I) and (II) electrophilic fluorination agents, DeoxoFluor™ reagent, and improved process technology for important commercial products that include NF_3, SiF_4, C_4F_6, and F_2. In the recent past he was responsible for HF process research for the development of low GWP fluorochemicals 1234yf and 1233zd as well as diversification of fluorochemical products and technologies outside of traditional refrigeration and foam expansion applications. Bob has held the position of visiting scientist at the University of Albany since 2009 and is a Research Fellow in the Chemistry Department of Lehigh University since 2017. Currently he is Chief Scientist of Electronic Fluorocarbons with responsibilities for the development of high-purity products for advanced semiconductor manufacturing including new ALD, ALE, and RIE candidates and also Principal of the consulting company Fluorine Chemistry and Technology (F2ChemTech), LLC. Bob served the ACS Division of Fluorine Chemistry as Vice-Chair Secretary-Treasurer (1999-2001), Chair (2002), and as Treasurer from 1999 to present. Bob was inducted into the 2016 Class of ACS Fellows and is the 2020 recipient of the ACS Award for Creative Work in Fluorine Chemistry – just the second industrial fluorine chemist to win this award since its inception in 1972.