Diffusion and Solubility of Common Microelectronic Airborne Molecular Contaminants into PEI thin Polymer Membranes and its Related Contamination Control Applications

P. González-Aguirre1,2, M.P. Tran2, S.I. Moon1, J. Lundgren1, C. Beitia2, H. Fontaine2

1Entegris, SAS, Parc Centr’Alp Ouest, 196 rue du Rocher de Lorzier, 38430 Moirans, France
2Univ. Grenoble Alpes, 38000 Grenoble, France - CEA, LETI, MINATEC Campus, 38054 Grenoble, France

Fabs are chemical process facilities that use some of the most aggressively corrosive and, in many cases, toxic substances seen in industry. In 90’s FM (Factory Mutual) Global and other fire protection professionals stepped forward about how to improve fire safety. Today process tools as wet benches are almost exclusively constructed out of materials that have been tested and certified by FM approvals [1]. The silicon substrates (also known as wafers) upon which microchips are manufactured inside a cleanroom are in fact stored and transported to the different fabrication steps within polymer-made containers called FOUPs (Front Opening Unified Pod) and then, the final piece of the fire-safe puzzle was the development of a FOUP capable of passing the FM4911 non-fire propagating FOUP standard. At the beginning of 2009, the first FM Approved FOUP became a reality: The PEI FOUP.

Sorption and outgassing mechanism of toxic gases in relation with lost wafers yield, is crucial information to understand the cross contamination inside a container FOUP. Cross contamination between FOUP and wafer occurs when polymers outgas contaminants into the surrounding environment. Gas sorption is governed by surface adsorption, followed by diffusion and solubility and diffusion appears as key parameter to understanding this cross contamination phenomena [2]. In this work, we present the transport coefficients obtained for gaseous HF and HCl at cleanroom conditions (Patm, 21 ± 2°C & 40% RH) and two different HX concentrations using the sorption kinetic method, based on Fick’s law, for thin films (50μm) of PEI. Finally, we establish the relationship between the sorption parameters of a polymer thin film and the potential contamination transfer from a FOUP whose main polymer material is similar.