

Use of PFAS/PFOA Compounds by U.S. SIA Members in 2008

Introduction

The Semiconductor Industry Association (SIA) and International SEMATECH Manufacturing Initiative, Inc. (ISMI) have signed a Memorandum of Understanding, dated 9/16/2009, in order to collaborate in a survey on the current use of perfluorinated compounds in the semiconductor industry. The purpose of this survey was to identify, by application, the quantity of PFAS, PFOA and related compounds used in the U.S. semiconductor industry in year 2008 and to determine the status of the availability of alternatives.

Perfluoralkylsulfonate (PFAS) and Perfluorooctanoic Acid (PFOA) are critical to several semiconductor processes and in many cases have no known substitutes. Some of these anthropogenic substances have proven to be persistent in the environment, bio-accumulative in the food chain, and moderately toxic, and as a result, are the target of several emerging global regulations which intend to restrict or ban their use.

The results of this survey will inform the World Semiconductor Council (WSC) associations on the quantities of these perfluorinated chemicals used in the United States and the criticality of these compounds to semiconductor manufacturing. The WSC will use this knowledge to assess regulatory concerns and risks to supply as well as to determine the actions necessary to ensure the future use of these compounds in the most critical applications on a global basis.

Survey Methodology

A survey questionnaire was prepared by ISMI which included a survey template, instructions for collecting the data and a list of formulas (including CAS and EC numbers) for PFAS, PFOA and related chemicals. The survey participants were instructed to send this template to their chemical suppliers to determine the kilograms of PFAS, PFOA and related chemicals that were sold to U.S. fabs during year 2008. The individual semiconductor companies were asked to consolidate the data from their suppliers and to enter the total quantities for each application in the survey template.

The survey template listed potential lithography and other process applications and asked for quantities of chemicals used in terms of the following five categories: PFAS C1-C4, PFAS C5-C7, PFOS C8, PFAS \geq C9, PFOA & Related Compounds. In addition, the template asked for the function of the fluorinated compound, by application, and the status/timing of alternatives.

Each semiconductor company sent one consolidated set of data for all U.S. semiconductor operations in the form of the survey template to ISMI, which rolled up the data received from the respondents. Completing the surveys in this way preserved respondent identities as well as those of the chemical suppliers. Supplier identities were not divulged by the survey participants and, in turn, the identity of the survey participants will not be divulged by ISMI during the process.

Survey Results

Six (6) semiconductor manufacturing companies participated in the survey. One company was not able to obtain quantitative data from their chemical suppliers and one did not obtain data from their lithography suppliers but did survey suppliers of non-lithography process chemicals. Data on the availability of alternatives or replacement chemicals, with equal or better performance was obtained, but the timing of these alternatives for insertion into high-volume manufacturing was not reported.

The consolidated survey results, based on the data provided by the six companies that participated, are shown in Table 1. The table shows the total quantities (in kilograms) used or purchased by the ISMI and SIA members during 2008, broken down into five groups according to the number of carbons in the backbone of the chemical.

It appears the applications that use the most perfluorinated compounds are in photolithography for photoresists and top anti-reflective coatings (TARCs). The chemical suppliers report that alternatives are being developed and replacement of PFAS/PFOA containing resists and TARCs is ongoing. Similarly, for bottom anti-reflective coatings (BARCs) replacement is ongoing.

Significant quantities of PFOA and related compounds are also used as surfactants in chemical-mechanical polishing (CMP) slurries. However, plans are to phase out that application in the second quarter of 2010. Very small amounts of PFOS and PFAS (C5-C7) are being used in process applications such as color filter, developers, wet etchants and chrome etchant.

Table 1 – Quantities of PFAS/PFOA Used By U.S. SIA Members

Process chemistry type		Weight sold/used (kg/yr - 2008)					Perfluorinated compound function	What is the timing for alternatives to be available (Except for C1-C4 PFAS)?
		PFAS C1-C4	PFAS C5-C7	PFOS	PFAS ≥ C-9	PFOA & Related Compounds		
Lithography	Resists	336.40	0.00	6.29	0.00	1.80	surfactant and/or photo-acid generator	replacement ongoing; 2010 for PFOA
	TARCs	0.00	0.00	7.77	0.00	115.54	surfactant and/or active coating	replacement ongoing
	BARCs	1.00	0.04	0.69	0.00	0.00	surfactant and/or photo-acid generator	replacement ongoing; 2010 for PFOA
	Etchants	7.16	0.00	0.00	0.00	0.00	wetting agent	
	Protective Coating	0.003	0.00	0.00	0.00	0.00		
	Color Filter	0.002	0.0003	0.00	0.00	0.00		
	Developers	0.00	0.0020	0.00	0.00	0.00		product now obsolete
Other	Wet Etchants	0.00	0.00	2.30	0.00	0.00	surfactant	use stopped in 2008
	CMP Slurries	0.00	0.00	0.00	0.00	66.50	surfactant	replacement in Q2, 2010
	Chrome Etchant	0.00	0.00	0.10	0.00	0.00	surfactant	