Application Number: E.2.11 (Electronics and Semiconductors)

Application Name: Semiconductor Manufacturing Equipment

· We are applying for exemptions for the following applications of PFAS used in semiconductor manufacturing processes.

Subject to use: All of semiconductor manufacturing processes, including applications to semiconductor manufacturing equipment (photoresist equipment, etching equipment, cleaning equipment, and all other equipment), infrastructure equipment, etc.

Chemical solution to use: Hydrofluoric acid, nitric acid, sulfuric acid, hydrochloric acid, aqua regia, hydrogen peroxide, ammonia, ultrapure water, and their mixed solutions

Usage environment: High temperatures (RT to about 200°C), pressurized and depressurized environment

Use conditions: No metal elution or contamination in the usage environment. Maintain purity, Impervious to chemicals, heat and flame retardant.

Required to meet the above specification conditions, and no alternative product is considered to exist at this time.

Alternatively, alternative materials will significantly increase the defect rate, which will have a significant influence on productivity and prices. As a reason of this, PTFE (CAS NO:9002-84-0), PCTFE (CAS NO:9002-83-9), PFA (CAS NO:26655-00-5), PVDF (CAS NO:24937-79-9), and ETFE (CAS

NO:94228-79-2) have excellent chemical resistance compared with other plastics, and comparative examples thereof are shown below. *1)

Table 2 Chemical and Solvent Resistance of Various Plastics and Rubbers*

Chemicals And Solvents (Concentration: %)	Material	Polyethylene	Polypropylene	Poly(4-Methylpentene)	Polyvinyl Chloride Soft	Polyvinyl Chloride Hard	Polymethylmethacrylate	Polystyrene	Polyvinylidene Chloride	4-Fluoroethylene	Silicon Rubber	Fluororubber
Hydrochloric Acid	(10)	◎	◎	◎	○	◎	○		◎	◎	○	◎
	(36)	◎	◎	◎	△	◎	○		◎	◎	×	◎
Nitric Acid	(30)	○	○	○	△	○	×	×	○	◎		◎
Sulfuric Acid	(10)	◎	◎	◎	◎	◎	◎	◎	◎	◎		◎
	(98)	△	△	△	×	△	×	×	×	◎	×	◎
Formic Acid	(90)	◎	◎	◎	×	○	×		○	◎	○	△
Acetic Acid	(10)	◎	◎	◎	○	◎	○		○	◎	○	○
	(100)	△	△	◎	×	△	×		×	◎	○	○
Aqueous Ammonia		◎	◎	◎	○	◎	○		◎	◎	◎	◎
Sodium Hydroxide (10)		◎	◎	◎	○	◎	○	◎	◎	◎	×	○
Ethanolamine		○	○	○	×	×				◎	○	×
Ethylenediamine		○	○	○	×	×	×			◎	◎	×
Pyridine					×	×	×			◎		×
Methanol		○	○	○	×	○	×		△	◎	○	○
Ethanol		○	○	○	×	○	×		○	◎	○	◎
Isopropanol		◎	◎	◎	×	○	×		○	◎	◎	◎
Ethylene Glycol		◎	◎	◎	×	△				◎	◎	◎
Diethyl Ether		×	△	×△	×	△			×	○	×	×
Diisopropyl Ether		○	○	○	×	△	×			◎		×
Dioxane					×	×					△	×
Formaldehyde (40)		○	◎	◎	○	○	○		○	◎		◎
Acetone		△	△	△	×	×	×	×	×	◎	○△	×
Methyl Ethyl Ketone		△×	△	△	×	×	×	×	×	◎	△	×
Ethyl Acetate		△	△	△	×	×	△		×	◎	△	×
Butyl Acetate		△	△	△	×	×	×	×	×	◎	×	×
Hexane		×	△	×△	×	○	△			◎	×	◎
Isooctane		△			×	×	△			◎	×	◎
Benzene		△	△	△	×	×	△	×	×	◎	△	○
Toluene		△	△	△	×	×	△		×	○	×	○
Methylene Chloride		×	△	×△	×	×	×	×	×	◎	×	○
Chloroform		×	×	×	×	×	×	×	×	○	×	○
Carbon Tetrachloride		×	△	×△	×	×	×	×	×	◎○	×	◎
Chlorine Gas		△	△	△	△	○	○	◎	○	○		◎
Ammonia Gas		◎			△	○			×	◎	◎	×
Ozone		△			○	○	△		◎	◎	◎	◎
Potassium Permanganate (5)		◎	◎	◎	○	◎			◎	◎		
Sodium Hypochlorite (5)		◎	◎	◎	○	◎	○		◎	◎	◎	◎

Resistance to inorganic chemicals was determined based on changes in the appearance of the sample, the degree of liquid contamination, and changes in physical properties. ◎= Superior: No or little influence, ○= Good: Some influence, but can withstand use under certain conditions, △= Possible: Should not be used as much as possible, ×= Bad: Not suitable for use due to severe influence.

Resistance to organic oils and solvents was determined by immersing the sample at room temperature for 48 hours, measuring the weight change rate, and classifying according to the followings. Weight change rate = ◎: 10% or less, ○: 11~30%, △: 31~100%, ×: 101% or more

*Excerpted from references 1) and 2).

Table shows results obtained at room temperature. Resistance decreases at high temperatures, so the materials may be usable at room temperature but not at high temperatures.

References

*1) National Research and Development Agency Japan Science and Technology Agency, Masahiro Natsume, Nagoya University, Faculty of Agriculture, "Chemical and Solvent Resistance of Plastic Laboratory Equipment"

· We are applying for exemptions of PTFE (CAS NO:9002-84-0), PCTFE (CAS NO:9002-83-9), PFA (CAS NO:26655-00-5), PVDF (CAS NO:24937-79-9), and ETFE (CAS NO:94228-79-2), which are PFAS used in semiconductor manufacturing processes. Because they are high molecular weight materials (polymers), there are no concerns about exposure, spill, or environmental release of low molecular weight (monomer) PFAS during use.
(Reference, SDS of PTFE in Daikin Industries, Ltd.)

· As mentioned above, the use of high molecular weight (polymer) PFAS is essential for the temperature environments and chemicals used in the semiconductor manufacturing processes.
The size of the semiconductor market in 2022 is approximately $600 billion *2). If high molecular weight (polymer) PFAS is regulated, the influence on society would be immeasurable. Semiconductors are used in smartphones and satellites, and their influences on advanced technology are also immeasurable.
*) ↑ Influence on "wide range of industrial applications such as semiconductors, automobiles, and batteries" that will hinder the achievement of the European Green Deal

https://eumag.jp/wp-content/uploads/2020/02/green_deal.pdf

· We propose a permanent exemption for the above reasons.

References

*2) EETimes Japan, "Global Semiconductor Market Size to Exceed US$600 Billion by 2022"