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To: ECHA (European Chemicals Agency)

**Public comments by Shin-Etsu Chemical Co., Ltd (Japan) on
the proposal from EU REACH to ban PFAS in materials
for semiconductor production process**

< Contents >

- **About Shin-Etsu Chemical**
- **Problematic Scope of the PFAS restriction in EU**
- **Request of PFAS exemption for semiconductor use**

1. About Shin-Etsu Chemical

< Origin >

Shin-Etsu Chemical Co., Ltd. began with the coming together of Nagano Prefecture's (Shinano-area) water and Niigata Prefecture's (Echigo-area) limestone.

Nagano Prefecture's plentiful water gave birth to electric power and the limestone that came from Niigata Prefecture was a key raw material, which was called, "Oyashirazu's great earth."

Because of the presence of these two gifts of nature, Shin-Etsu Nitrogen Fertilizer Co., Ltd. was founded on September, 1926 to manufacture chemical fertilizer and limestone nitrogen. The history of Shin-Etsu Chemical Co., Ltd. began from this point. The company's "Shin" comes from Shinano and "Etsu" is taken from Echigo.

< Business and Products of current Shin-Etsu group >

The H.Q. of Shin-Etsu Chemical Co., Ltd. is located in Tokyo. The Shin-Etsu Group makes a wide array of products for use in a broad range of industrial fields by drawing on the production technologies accumulated in the process of continuously diversifying and improving its product offerings. By reciprocally maintaining close relationships, our business mix extends across many different fields, and we have built a robust business structure impervious to economic conditions.

We have a lot of products for the semiconductor field like Silicon wafer, Photo resist & related materials, Mask blanks & EB resist materials for lithography and Molding compound for semiconductor encapsulation etc. Regarding our business and products, we show you the Annual report as the attached. We especially would like to focus on the materials for semiconductor field, regarding PFAS.

2. Problematic Scope of the PFAS restriction in EU

(1) Current status of Semiconductor business

Semiconductor devices in our current society and life are rapidly becoming more important in the world. They are used in many electric tools. It is so difficult to find anything not to use semiconductor devices. They and the materials and equipment for semiconductor are actually manufactured in specific region. So, this supply has been directly influenced by the change of economic and political status. Semiconductor devices have become strategic goods especially after Russian invasion of Ukraine.

(2) Lithography process for semiconductor production process

Lithography process is one of the most important processes in semiconductor production process for manufacturing Large Scale Integrated circuits (=LSI). Without this process, LSI cannot be made. We, Shin-Etsu provide the photo resist materials, EB resist materials, middle layer materials and under layer materials to semiconductor manufacturers and photo mask manufactures as our customers, in which PFAS are used for improving each performance.

If we cannot use PFAS, we will not be able to continue to provide lithography materials with same level's performance. Semiconductor manufacturers as our customers are always requesting us to improve our materials' performance and quality because of their improvement of the device yield.

3. Request of PFAS exemption for semiconductor use

(1) Our proposal to PFAS restriction

We strongly request ECHA as the EU REACH Authority to accept PFAS exemption for the photo resist materials, EB resist materials, middle layer materials and under layer materials for semiconductor use. This reason is as below.

- We, Shin-Etsu Chemical are responsible for maintaining the supply of photo resist materials, EB resist materials, middle layer materials and under layer materials to semiconductor manufacturers and photo mask manufactures that are located in EU. At the moment, we do not have alternative materials to PFAS. We cannot concretely predict when we will be able to develop and have alternative materials to PFAS in the future.

EU countries are attracting new fabs for high-end semiconductor devices in EU area as each country's strategy. The European Chips Act will strengthen manufacturing activities in EU. EU plans aim to reach the target to double the current global market share to 20% in 2030. Please see the attached press release.

We, material suppliers need to supply lithography materials to these fabs. We

believe this meets the request of EU countries. If semiconductor fabs cannot get the lithography materials to meet their requested quality, they cannot run the semiconductor production process.

(2) Details of materials containing PFAS :

A Product group : Photo resist materials, EB resist materials, middle layer materials and under layer materials for lithography

No 1. Surfactant : Polymer including trifluoromethyl unit

The F component produces low surface tension and forms a homogeneous coating film by spin-coating on silicon wafers. Alternative surfactants without C-F groups do not produce a homogeneous coating film and do not perform well as resist and undercoat agents.

No 2. Polymer : Polymer including trifluoromethyl unit

The acidity of the hydroxyl group of fluoro alcohols is used to increase solubility in alkaline developer solutions to achieve good pattern formation and also contributes to etching resistance. Alternative resins without C-F groups do not provide resist performance.

No 3. PAG(Photo Acid Generator) : including PFBS; Perfluorobutanesulfonic acid and its salts, etc. and/or alkanesulfonic acid and its salt with polyfluoroalkyl or perfluoroalkyl unit

Generates a strong acid in the exposed area and realizes pattern formation as a chemically amplified resist with an acid catalyst function. The F component contributes to the strong acidity. Alternative acid generators without C-F group cannot demonstrate resist performance.

No 4. Additive : Polymer including trifluoromethyl unit

The F component reduces elution from the resist coating film to the upper layer and air. The alternative component without C-F group does not deliver the expected function.

B Product group : Materials and Equipment for the production of Product group A

No 5. Coating and packing materials : PTFE, Teflon etc.

- Avoid contact with metal surfaces by coating stainless steel to avoid contamination with Fe, Cr, Ni, etc. Avoid metal contamination and chemical leaks by using Teflon components.
- PFAS is used for coating material for inner bag of plastic bottles in which photo resist materials, EB resist materials and related materials are bottled. This coating material is essential in semiconductor use for maintaining the quality for photo resist and related materials.
- Piping for semiconductor use to be coated with Teflon containing PFAS is also essential for semiconductor production process.

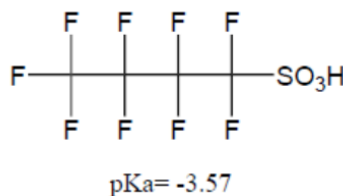
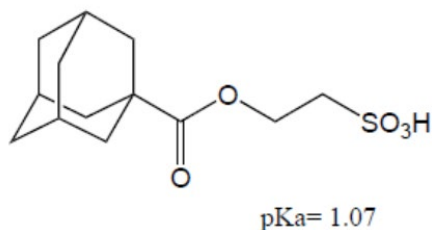
Regarding the items of No1 - No5 as above, there are no alternative materials. We request ECHA to accept PFAS exemption for these semiconductor uses.

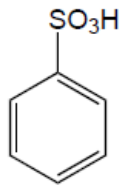
- (3) Technical reasons to justify the need for PFAS materials for the photo resist materials, EB resist materials and related materials

Example : Photo resist materials for lithography

< CASE 1 >

- PAG : pKa comparison between fluorinated anions and non-fluorinated ones



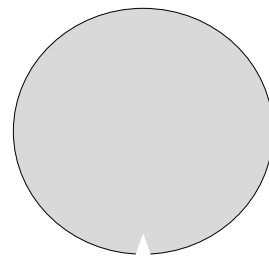


$\text{pK}_a = -0.60$

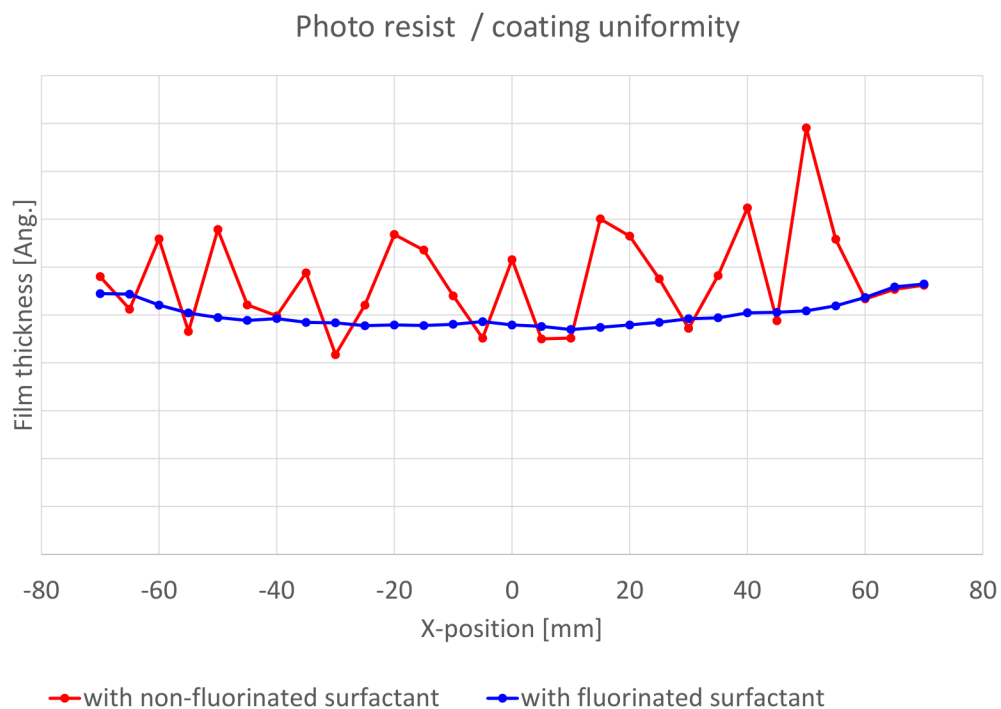
- Lower pK_a sulfonic acid (=higher acidity) is essentially needed to realize high contrast imaging for photo resist materials.

< CASE 2 >

- Surfactant :
Necessary for coating uniformity of photo resist materials
Fluorinated surfactant is essential for coating uniformity.



200mm wafer / 29pts



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