

## General comments

In the semiconductor industry in detail the polishing of wafers to a particular thickness strong acidic medias are used. To prevent leaching of foreign metals into the wafers a PFA or PTFE fluoropolymer is used on the equipment on various parts. The wafer industry uses long term qualifications for their system and fixed processes are used for more than five years before changing to recover the immense investments.

Therefore we propose to add semiconductor industry with the sub-use manufacturing devices to form wafers.

We do the coating of these components with PFA or PTFE and our socio economic impact is low compared to the downstream use of our components at the builder companies of the polishing machines and the companies doing the polishing for the known chip companies. We expect drawback on the European chip industry and the export of the equipment to the Asian markets.

## 1. Sectors and (sub-) uses

| Sector                   |                   |                                                    |
|--------------------------|-------------------|----------------------------------------------------|
| Semiconductor industries | Waiver production | manufacturing equipment to form and polish waivers |

## 2. Emissions in the end-of-life phase

The products we use are produced by OEM manufacturers. We use roughly 50 tons in the Aalberts group of coatings containing fluoropolymers in a range of 5 to 60 weight percent of PFAS. Our product manufacturers like Chemours, PPG, Daikin, Weilburger and others will deliver the whole tonnages into the coating market. We identified more than 237 commercial products containing PFAS or need PFAS for the formulation. That shows the broad range of applications and customer needs.

General waste is regulated strongly in Germany according to the Kreislaufwirtschaftsgesetz (KrWG). Waste is sorted into general and dangerous waste numbers. The coatings we apply fall under dangerous goods and are handled with special care under designated waste key numbers.

Our products are applied in very segregated areas by spray or dipping processes. During the application or production phase we emit mainly solvents and no polyfluorinated emissions to the air. The cabins have ventilations with filters which catch liquids, particles or none reacted products. The overspray which is not taken by the airstreams is solidifying on cardboard or foils in the cabinet or the rigid concrete floor. Those oversprays are broad to the general waste cycles in Germany and are burned or stored in specialized land fill. Liquid residues are collected and going to the special waste cycle and get thermally treated in waste plants. The material on the components for the industry is rigidized and cured in ovens. During use in production facilities during lifetime the coatings erode mainly, and emissions are banned locally in the productions sites and transferred into the waste stream cycles.

The components for the polishing equipment are used for a very long time >10 years recycled and recoated by refurbishment. During the refurbishing the fluoropolymers are pyrolysed to non harmless fractions. Defect or end of life systems are broad to the recycling systems in terms of mills and melting ovens where the PFAS are pyrolysed or in safe environments.

Liquids from dipping and rinsing are sent to the wastewater purification system and the resulting wastewater is transferred to the wastewater refurbish plant. Concentrations of critical substances are set as limit by the authorities. Concentrated bathes are part of the waste management according to the Kreislaufwirtschaftsgesetz (KrWG).

The total use of material for this purpose is about 2 tonnes per year. Therefore, the end-of-life emissions are below a few kilograms per year in this sector.

It is to be highlighted that fluoropolymers do not degrade, or they are not mobile, bio accumulative, or toxic and can be handled safely across the waste management and end-of-life cycle.

### 3. Emissions in the end-of-life phase

During handling and production on our sites less than 0.1 % are emitted to the environment. The rest is cached or degraded fully to non PFAS in pyrolysis. Components which are landfilled are not leaching out due to the rigid form and they are bound in other polymers. So the emission in the environment as free PFAS is not given.

## 4. Impacts on the recycling industry

No impact due to the regulations in the Kreislaufwirtschaftsgesetz (KrWG) in Germany and respective laws in the European states.

The attempt to serve better the ban is to create a waste key for fluoropolymer containing waste to regulate directly thermal treatment and land fill requirements as this regulated for other critical substances as cadmium, blasting media or others.

## 5. Proposed derogations – Tonnage and emissions

The emissions to the environment will be very low and due to the long qualification times in this kind of industry the time for the development, testing and implementation will be much longer as EiF + 18m

**Therefore, we propose:**

Ban with a transition period of 18 months and a 12-year derogation, because it could take a relatively long time (several years to several decades) to transition towards using alternatives that can achieve the same level of performance.

Continued R&D increases the chance that alternatives for the relevant applications will be identified in the next decade.

## 6. Missing uses – Analysis and socio-economic analysis

| Sector           |                   |                                                                                                                                                                                                                                                                              |
|------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Medical industry | Sector as a whole | All parts and components which are used for medical applications were European medical regulations need evidence of being harmless in the direct contact or close to the patient e.g. premature baby incubators, narcotic systems and related clinical of medical equipment. |

## 7. Potential derogations marked for reconsideration – Analysis of alternatives and socio-economic analysis

The research of alternatives just begun in 2023 after the final draft was set up. All of the alternatives have at least TRL 3 some do have already commercial products on TRL 9 to 11. However, those alternative did not undergo long term testing on the polishing machines. It is worth to mention that a polish company uses a set of 20 to 100 polishing machines with long time polishing cycles. To have a robust system there is a need of long term testing.

- Alternatives for Fluoropolymer applications:

| Alternativs                    | Remarks                                                                | Commercial products                                                                                                                                                                   | Performance                                                |
|--------------------------------|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|
| Polyetherether Keton<br>- PEEK | High performance polymer and good chemical and temperature resistance. | yes, however nonstick or adhesion properties missing. Already applied were alternative to PFAS even at higher price                                                                   | suitable only for particular applications                  |
| Polyimide - PI                 | temperature and chemical resistant                                     | yes, very limited and not as developed for the use. Maybe a product which can be developed . For application with coatings solvent NMP is needed which is considered to be restricted | only single use applications.<br>No widespread alternative |



|                        |                                                                                                                                             |                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Polypropylene          | thermoplastic polymer, chemical resistant                                                                                                   | yes, commercial products are available but not sufficiently developed as fluoropolymer substitute                                                                | no high temperature stability                                                                                                                                                                                                                                                                                                                                           |
| Polysulfone            | high performance thermoplastic polymer with the highest temperature resistance in the thermoplastic world.                                  | not known as coatings to us                                                                                                                                      | erodes under sunlight and the ultimate temperature is limited. Not resistant against chemicals and solvents.                                                                                                                                                                                                                                                            |
| Polyoxymethylene - POM | High performance thermoplastic with high strength, gliding properties and thermal strength                                                  | not known as a coating research and development needed to get performance and replacements for environments and conditions fluoropolymers are used at the moment | no coating known and feasibility as substitute not proven                                                                                                                                                                                                                                                                                                               |
| Siliconpolyester       | high performance thermosets with resistance to outdoor weathering, UV light, salt spray corrosion, oxidation, detergents, and thermal shock | yes, performance and durability below fluoropolymers. Further development and field testing needed.                                                              |                                                                                                                                                                                                                                                                                                                                                                         |
| SolGel                 | a process for the application of solids.                                                                                                    | yes, in particular areas fluoropolymers are substituted                                                                                                          | limits in various applications due to the application and drying processes on complex and large components e.g. Rollers. Main limits are in the industry standard application by skilled workers and the non defect acceptance. Further application research and practicality of use for these products in manual application are needed. This will take several years. |

The socio economic effect is in the case of our plants 300.000€ and 5 employees. However, the socioeconomic effect on final customer will be of a hundred million euro and a production line that will fully be stopped. Application of the fluoropolymer needs approval by the OEM and can not be transferred in reasonable time out of the EU regulations. We estimate a loss down the supply chain for such polishing devices of 2000 employees and a loss of 500 to 1000 m.€ downstream the supply chain.