European Sealing Association e.V.

Case study: **Use of fluoroelastomer Sealing elements in the Semiconductor Chip manufacturing process**

There is no other chemistry available to replace the performance that Fluoropolymers provide for chemical, thermal, plasma and radioactive resistance as seals. By definition any chemical that could withstand those situations would also be considered persistent.

A ban, or a class regulation, of polymeric PFAS materials and their raw materials will have a profound impact on global industry and everyday lives. The following case study is given to showcase just a tiny fraction of the uses of PFAS sealing materials where no alternative technology exists.

Key facts:

- Semiconductor market size has grown from 204 billion USD in 2000 to 527 billion USD in 2020 [i]
- Drive for better energy efficiency to increase device battery lifetime or lower power consumption
- Computing power 2x every 2y with same or lower energy consumption
- 2021 European chip act to regain tech sovereignty

The electronics market needs microprocessors that are faster & more powerful (Moore Law shows a 2x increase in transistor density in chips every 2 years [ii] and at the same time chips become more energy efficient to reduce the global emissions). In order to achieve this, semiconductor components require thinner (7nm and below) microchip engraving. 5nm technology developed by TSMC is used for example in the latest A15 processor powering the Iphone 12.

The drive for energy efficiency can be observed by the move for HDD (Hard Disk Drive) to SSD (Solid State Drive) which use microchip as memory. SSD consumes 2 to 3 times less energy than HDD. This translates in less power consumption and less heat generated that would otherwise require air conditioning in data centres.

State of the art chip engraving technology uses processes that combine temperatures above 200°C with fluorine plasma and highly polar chemicals. Engraving at a nanometer scale, 5 nm at present and with demand for thinner engraving, is highly sensitive to nanometer particulate contaminants.

By announcing a European Chips Act in her State of the European Union address in 2021, President Ursula von der Leyen sent a strong geopolitical and economic signal to enhance European production capacity for semiconductors and European tech sovereignty. [iii]

The use of fluoroelastomer or perfluoroelastomers is essential to seal the ultra-clean processing chambers used to manufacture chips and to enable thinner chip engraving. No other class of material exists that can meet the requirements of combination of lifetime, fluid compatibility, plasma exposure and temperature. [iv] [v]

[i] source statista/WSTS semiconductor market forecast 2021
[ii] Moore's law – Wikipedia
[iii] https://ec.europa.eu/commission/commissioners/2019-2024/breton/blog/how-european-chips-act-will-put-europe-back-tech-race_en
[iv] *Contamination Considerations for Perfluoroelastomer Seals used in Deposition Processes IEEE, May 2008*
[v] *Journal of Vacuum Science & Technology A 38, 013002 (2020); https://doi.org/10.1116/1.5124533*