JAPIA
Japan Auto Parts Industries Association

Second Position Paper
PFAS Restriction Public Consultation

Japan Auto Parts Industries Association (JAPIA) Position to Annex XV Restriction report on 22 March 2023 about a proposal for a restriction on Per- and polyfluoroalkyl substances (PFASs)

1. Introduction

This document supplements the first position paper from us, JAPIA, which submitted in Part 17, 4413. In order to avoid duplicate submissions of the same information (based on the Q&A in the ECHA webinars), this second position paper contains only additional information as possible. Against this background, this document will have the same chapter structure as the first position paper (Part 17, 4413) so that the additional information can be easily understood.

Definitions in this document

- ✓ Fluoropolymer(s) in this document are defined to include fluoroplastic(s) and fluoroelastomer(s).
- ✓ The derogation period referred to in this second position paper excludes the transportation period (18 months). In other words, the proposal for a 12 years derogation period means "paragraphs 1 and 2 shall not apply to [***] until 13.5 years after EiF".

2. Executive Summary

Please refer to the first position paper, as the executive summary we wish to argue is the same.
In this second report, we have added information that was missing in the first position paper. Additional information, in particular is provided in Chapter 5

"Functions of PFASs used in automotive components and possible alternatives", and Chapter 6 "Environmental release of PFASs".

3. Concern about the proposed restriction

There is no additional information. Please refer to the first position paper.

4. Automotive components containing PFASs

In the first position paper, we submitted the following two attachments in Chapter 4. In the second position paper, Attachment 1 will be revised. I am adding additional applications (auto parts) that were newly discovered in additional research. We inform you that this Attachment 1 is still not exhaustive.

Attachment 1：Non-exhaustive list of applications
(Confidential and Non-confidential)
Attachment 2：Non-exhaustive picture list of applications

Revised Attachment 1 is a non-exhaustive list of applications containing PFAS; two versions are attached, Confidential and Non-confidential.
the Non-confidential version contains only parts information, while the Confidential version also contains PFASs information (substance name and Cas RN).
This list includes auto parts that are essential to ensure proper drivability of the vehicle. All of these auto parts are necessary to ensure safety in the use of the vehicle. However, parts intended solely for comfort enhancement, optical enhancement, or design are not included. In addition, due to assist in understanding these auto parts, please refer to Attachment 2 for pictures of some of attachment 1. However, this Attachment 2 has not been revised and is not attached in this second position paper (please refer to our first position paper).

5. Functions of PFASs used in automotive components and possible alternatives

For the excellent quantitative properties of fluoropolymers that refer in the description of this Chapter 5, please refer to Attachment 3 "List of properties (Comparison of properties of fluoropolymers and other materials in our first position paper (not included in this second position paper, as it has not been revised). The Attachment 3 indicates the exceptional properties of fluoropolymers relative to other materials that have been proposed as alternatives to fluoropolymers in the Annex XV restriction report.

This chapter discusses the need for PFAS (e.g., functions and roles) and possible alternatives for each component group. Information and data already submitted in our first position paper will not be mentioned here (please refer to our first position paper), but only if additional information is available, and the application also mentioned in our first position paper will be republished (such as "Air conditioning").

Application: Piston

- Product Examples

Piston in cylinder for engine

- Necessity of using PFAS

In order to satisfy the requirements of slidability and oil resistance, fluorocarbon compounds such as PTFE is used. The sliding property of the fluorine compound greatly contributes to the improvement of the fuel efficiency, and the prevention of the parts damage caused by the seizure between parts under the condition that the engine oil due to temperature or deterioration does not function sufficiently. In addition, since the piston comes into contact with water and acids that may be generated depending on the operating conditions, including engine oil, chemical resistance is also required. Therefore, fluorine compounds are required as materials with both sliding and chemical resistance.

- Concerns about substitution

Since no suitable substitute material is currently available, a long period of

alternative material development is required, and it takes more time to confirm normal operation as not only a piston but also an engine. It is assumed that a period of at least 10 years is required. Even if a substitute material could be developed, it is not realistic because it is necessary to evaluate each car model that has already been put on the market.
In terms of function, product function and fuel consumption are deteriorated by the sliding property reduction, and it becomes a serious negative effect to CO_2 reduction, and there is a fear that it becomes a big obstacle to the carbon neutral goal achievement.
Differences in frictional forces between PTFE containing coatings and PTFE free coatings are shown below. The friction force is reduced by 5 % when the coating is changed to the non-containing coating. The lower the frictional force of the piston, the better the fuel efficiency.

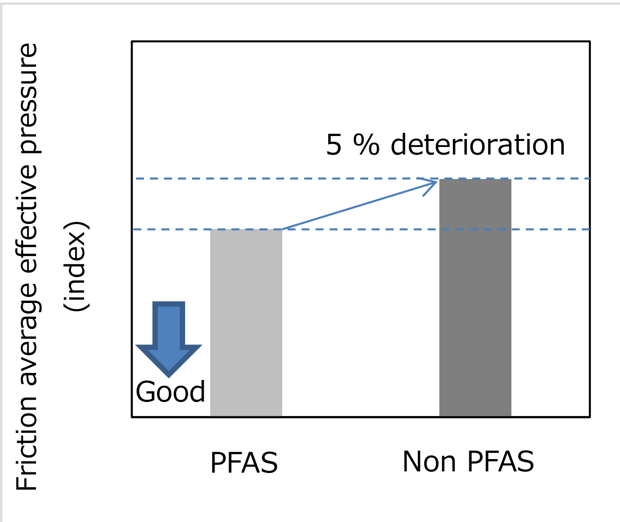


Figure Differences in frictional forces between PTFE containing coatings and PTFE free coatings

In addition, there is an increased chance of contact breakage between parts, and the piston does not operate normally, thus making it impossible to guarantee the safety of vehicle travel.

Application: Fluorine Coating

■ Product Examples

Door striker, Brake pad support, Brake shim, 2-piece brake disc connection disc spring, Door hinge (siding doors, sliding doors, tailgates, trunks, etc.), etc.

■ Necessity of using PFAS

Fluorine coatings are used to enhance slidability and durability under harsh conditions, such as automotive parts. There are two types of fluorine coating: one is to melt and coat fluoroplastic, and the other is to coat paint in which PTFE micropowder is dispersed.
For the types that coat paints with dispersed PTFE micropowders, the paints used are composed of solid-state lubricants, resins, and additives. PTFE, which is a PFAS, is used as a lubricating solid-state lubricant and is essential for the long-term safe operation of parts of motor vehicles. In addition, the use environment is various, and it is possible to coat a rubber product or a plastic product having low heat resistance.
In the case of the type in which the fluoroplastic is melted and coated, the parts are always rubbed together, and a lower coefficient of friction is used for the necessary parts. In that case, high heat resistance is also required because the high load physical contact between the parts occurs. In automotive parts, they are used for seals, bearings, bearings, brake pads, etc.
In plain bearing for various door hinge applications, low friction and wear resistance are required to prevent the door drop due to wear of the plain bearing and to ensure that the door can be opened and closed properly, while at the same time chemical resistance to car shampoo, wax, calcium chloride for anti-freezing of the road etc., and heat resistance to withstand the baking process during the paint of the car body are also required.
Fluorine coating contributes to miniaturization and weight reduction of automobile parts because it can receive high load in a narrow area, and also contributes to improvement of fuel consumption of automobiles. In addition, it is possible to suppress the occurrence of stick-slip due to the very small difference between static friction and dynamic friction, and it also contributes to the improvement of comfort through the reduction of noise and vibration, because it is a material with flexibility.
The components of the power source of the next generation automobile such as fuel cell and lithium ion battery must be free of fluorine coating with high chemical resistance in order to operate safely even in strong acid and strong alkaline

environment such as electrolytic solution.

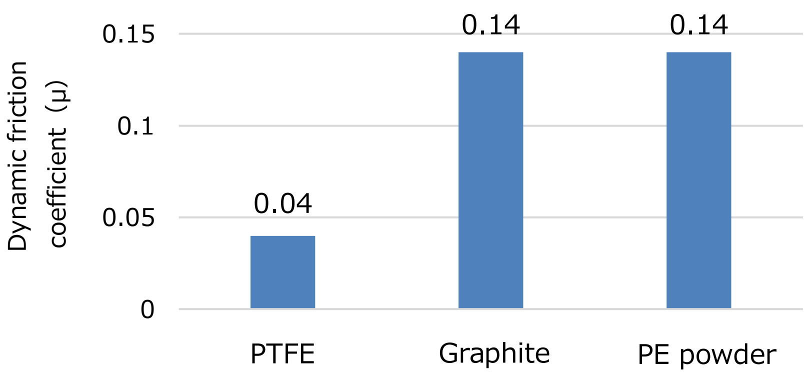
Further, since the fluorine coating has high chemical resistance, it is indispensable for manufacturing equipment that uses strong acid and strong alkali materials such as plating bathtubs and electrode and precision equipment manufacturing processes, and if the equipment is not coated with fluorine, the manufacturing equipment does not operate safely and the frequency of equipment replacement increases, so there is a concern about an increase in waste. Many of these facilities have been introduced by SMEs, and the negative economic effects of SMEs are unknown.

Fluorine-coating is used in various applications of automobiles, and most applications use PTFE because they need to have both several functions such as sliding property, heat resistance, flexibility, and chemical resistance. There is no alternative material other than fluorine that can combine such unique characteristics.

■ Concerns about substitution

For the types of coating paints with dispersed PTFE micropowder, the solid lubricant is also present other than PTFE, but there is no solid lubricant that is lubricious and durable equivalent to PTFE The following shows the dynamic friction coefficients of fluorine-coated materials using PTFE and graphite and polythene (PE) powder.

Lower coefficient of dynamic friction contributes to energy conservation in automobiles.



Consequently, PTFE has a lower coefficient of kinetic friction than other solid-state lubricants and exhibits good lubricity. This good lubricity also improves the durability of the parts. The use of PTFE is essential because components with higher loads or surface pressures on the component (such as Ex. bushing sunshade rail brake pad supports) have less frictional force than PTFE for solid-state lubricants other than PTFE, which may lead to premature component failure. Further, although PEEK

coating is present as an alternative to the fluorine-containing coating, it must be melted at 300 degrees. or higher at the time of coating, it is not a substitute material because it cannot be used for rubber parts or plastic parts.
In addition, the coating of PTFE micropowder can be produced by reducing energy-use during coating production, which contributes to reducing CO_2.
In the case of a type in which a fluoroplastic is melted and coated, there is no possibility of development of an alternative technique or a material at present. Substituting other materials results in loss of low friction properties and heat resistance, which makes it impossible to secure not only performance but also durability. As a result, consumer safety and comfort are compromised. In order to maintain safety, consumers incur considerable costs for maintenance and repair, and are often used in places that are invisible to consumers, which is likely to lead to serious accidents, such as missing the timing of requiring repair.

Below are examples of automotive fluorine coating use and alternative concerns. Note, however, that some of the examples are shown.

Door striker	Striker is inferior in wear resistance of parts when the lubricity is impaired, and there is a fear that parts may be damaged at an early stage. In the worst case, the door may open during driving, leading to a serious accident.
Brake pad support	If the lubrication of the pad support is impaired, the sliding of the part may be inferior, and the part may be damaged at an early stage. In the worst case, there is a risk that the brakes will not work while driving, leading to a serious accident. In addition, poor sliding performance results in poor fuel economy and increased CO_2 emissions.
Brake shim	Shims are inferior in wear resistance of parts when their lubricity is impaired, and there is a fear that parts may be damaged early. In the worst case, there is a risk that the brakes will not work while driving, leading to a serious accident.
2-piece brake disc connection disc spring	When the lubricity is impaired, the fitting coned disc spring is inferior in sliding property of the part, and there is a fear that the part will be damaged at an early stage. In the worst case, there is a possibility that the disk sliding part and the pad part may be broken and separated, and the

	brake becomes ineffective during running, leading to a serious accident.
Door hinge	If the sliding properties are impaired, the door tend to not shut properly because of slow down of closing speed. Similarly, impaired wear resistance can cause the door drop by wear of the bearing, resulting in a same situation especially when the door hit to a weather strip locally and strongly. In the worst case, the door may open while the driving, leading to a serious accident. If wear resistance is impaired, the sliding layer worn out quicker and start metal-to-metal rubbing. This may lead to weaken stiffness of the hinge assembly by wear of mating components. In addition, plating layer and paint layer rubbed off as well, resulting in massive rusting on the hinge, which may lead to the hinge not meeting safety standards. Chemical resistance is important for door hinges because hinges are exposed to a variety of chemicals, such as car shampoo, wax and calcium chloride for anti-freezing of the road. If the chemical resistance is not enough, the plain bearing material itself deteriorate and in the worst case, the door opening and closing functions may be impaired.

Application: Brake Pad

- Product Examples

Brake pads, friction materials, etc.

- Necessity of using PFAS

It is necessary to decelerate and stop the vehicle safely and stably at the deceleration intended by the driver under various conditions. For this purpose, stabilization of the friction force generated in the friction material and the disk rotor is required. Generally, it is known that the high-speed high-load period is likely to degrade the effect (fading [1]) and the effect after the overnight is raised (morning thickness [1]). On the other hand, when the vehicle is stopped for a long time, rust generated at the friction interface causes the phenomenon that the friction material sticks to the brake disk. When the rust sticking force is high, it may be impossible to start the vehicle. In order to solve these problems simultaneously, the water repellent action and heat resistance of PTFE have confirmed their effectiveness, and thus, it is possible to provide a safe braking.

1. Ensuring the effectiveness of high speed and high load

Recently, the power performance of vehicles has been improved, and in HV and EV vehicles, the demand for increased capacity of the onboard battery is increasing. Therefore, in the area where the regenerative brake does not work, the load of the brake becomes higher and the temperature rises. As a problem in the high-speed high-load area, there is a in which a friction coefficient of a friction material at a high temperature is reduced, which is called a fade phenomena [2]. In order to secure the friction coefficient at high speed and high load, it is necessary that the friction material has high heat resistance. Since the decomposition temperature of PTFE is high, it is that it is possible to guarantee the safety by contributing to the stabilization of the brake effect even in and high-speed high-load without generating the degradation of the brake by the gas fade [2], [3], [4].

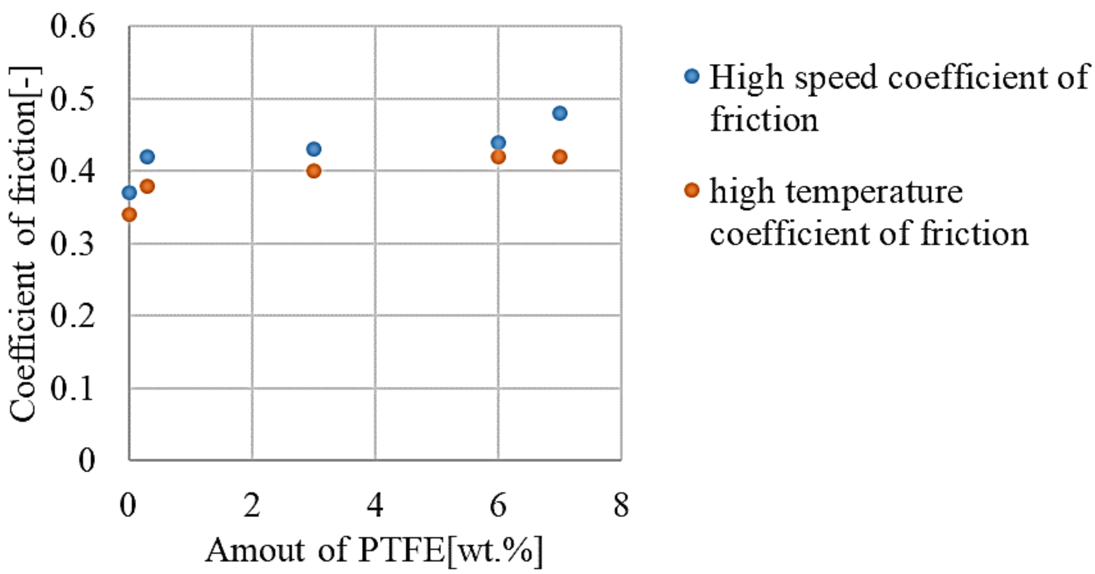


Figure Relation between PTFE content and high-speed and high-temperature efficacy (Graphing from AA11017016)

2. Restraint of the increase in effectiveness after leaving

It is known that a sudden rising effect (Morning Thickness [1]) is caused by braking after leaving it for overnight. This phenomenon is mainly caused by a drastic increase in the friction coefficient occurring between the friction material and the brake disk. The coefficient of friction increase is likely to occur under the environment where the brake disk is subject to condensation (mainly in the morning in winter). This is a due to a mix of wear dust and water [5]. Since the abrasion powder has a property of being easily mixed with water, it is difficult to mix the abrasion powder and the water by blending a PTFE having a high-water repellency into the friction material, and an increase in the friction coefficient is suppressed [6].

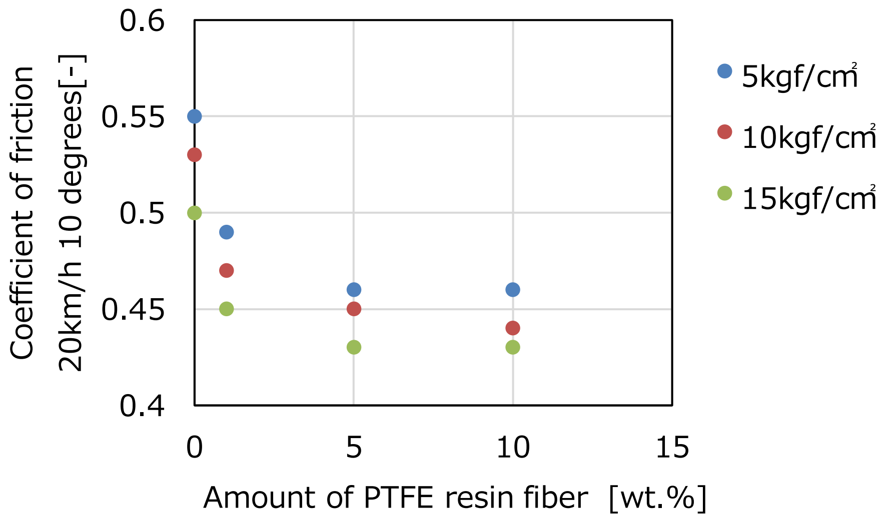


Figure Relation between PTFE fiber content and efficacy

(brake fluid pressure 5 to 15 ㎏ f/cm^2) *JP H 8-326805, Table 1,2 data

3. Suppression of rust adhesion

Rust sticking is a phenomenon caused by rust generated at the friction interface when the vehicle is stopped for a long time. Recently, the use frequency of the friction brake has decreased by the installation of the regenerative brake, and it has become difficult to discharge the rust from the friction interface. Together with the popularization of the electric parking brake, by the pressing force between the friction material and the disk rotor is forcibly applied, there is a tendency that the occurrence frequency of further rust sticking is increased. Rust adhesion, by blending a highly water-repellent PTFE to the frictional material, to suppress the uptake of water causing rust, a of preventing rust adhesion [7], [8]. Also, the load of the brake becomes high in the area where the regenerative brake does not work, the temperature rises. Therefore, in order to continuously obtain a water repellent effect, heat resistance is also required. PTFE is a that has both water repellency and heat resistance.

■ Concerns about substitution

If water repellency alone is expected, there is a possibility of replacing PE or so on, but does not have heat resistance as high as PTFE. Thermal analysis showed that the onset of heat loss of PE was about 470 degrees, whereas that of PTFE was about 550 degrees, which could not be an alternative.

addition, although there is a possibility of substituting for PEEK and the like if only the effect of heat resistance is expected, the water repellency is high in PTFE surface-energy 18 Dyne/cm, and PEEK is as high as 43 Dyne/cm and is inferior in water repellency. PTFE with both water repellency and high heat resistance is the only non-big material, and the performance cannot be satisfied with the alternative material.

<u>Evidence of information</u>

(1) JIS D 0106 Vehicles-Braking Terms
(2) Gazette AA10-285558
(3) Publication number : AA11017016
(4) International Publication Number: WO2021/010003 A1
(5) Goto Yoji: Applications of Friction Viewing Equipment--Factor Analysis of Friction Coefficient Variation Caused by Water-Wetting of Brakes--Automotive Engineering Society Papers, Vol.46,No4
(6) Publication number : JP H 8-326805
(7) Publication number : AA20152848
(8) Publication number : US11649869

Applications: Fuel Cell

■ Product Examples

Power generation cells for fuel cells

■ Necessity of using PFAS

Fuel cells are "power generators" that generate electricity through a chemical reaction between hydrogen and oxygen.
In the reaction mechanism, hydrogen supplied as fuel is dissociated into electrons and hydrogen ions on the anode side, which is the fuel electrode, and the hydrogen ions move through the electrolyte and the electrons move through the external circuit to the oxygen electrode on the cathode side, whereby electricity flows from the fuel electrode to the oxygen electrode, and on the oxygen electrode side, oxygen and hydrogen ions react to generate water.
Unlike rechargeable batteries, which are typified by lithium-ion batteries, it is possible to generate electricity continuously, and since the emissions are also clean with only water, it will be a technology that can make a significant contribution to a decarbonization society.
For automotive applications, "Polymer Electrolyte Fuel Cell (PEFC)" is used because of its superior startup performance, high power density, small size, and light weight, and its advantages over other fuel cells such as phosphoric acid and solid electrolyte (approx. 200 - 1000 degrees) in that it operates at a lower operating temperature (approx. 70 - 90 degrees) and is able to operate intermittently. "Polymer Electrolyte Fuel Cell (PEFC)" is an electrode consisting of a positive electrode and a negative electrode, which sandwich an electrolyte and sandwich the cell with separators.
In order to maintain high performance for a long period of time by supplying "hydrogen" and "oxygen" to the power generation cell, it is necessary to keep the humidified environment of the electrolyte membrane and stably supply hydrogen and oxygen to the respective electrodes without blocking them.
In order to provide such properties and functions, the gas diffusion electrode structure is provided with MPL layers having high water repellency so as to prevent clogging due to water accumulation in the micropores by transporting the water generated by the electrode reaction to the gas diffusion electrode, and to provide stable "hydrogen" and "oxygen", and a fluorine compound is used for imparting the water repellency.
Furthermore, in order to demonstrate high power generation performance, A high transport property of positive hydrogen ions (protons) is required, and an electrolyte membrane is strongly acidic with a high negative charge. Since it is necessary to

hold, a material which does not deteriorate even in strong acidification is required. There is no material other than a fluorine compound having both high water repellency and acid resistance function.

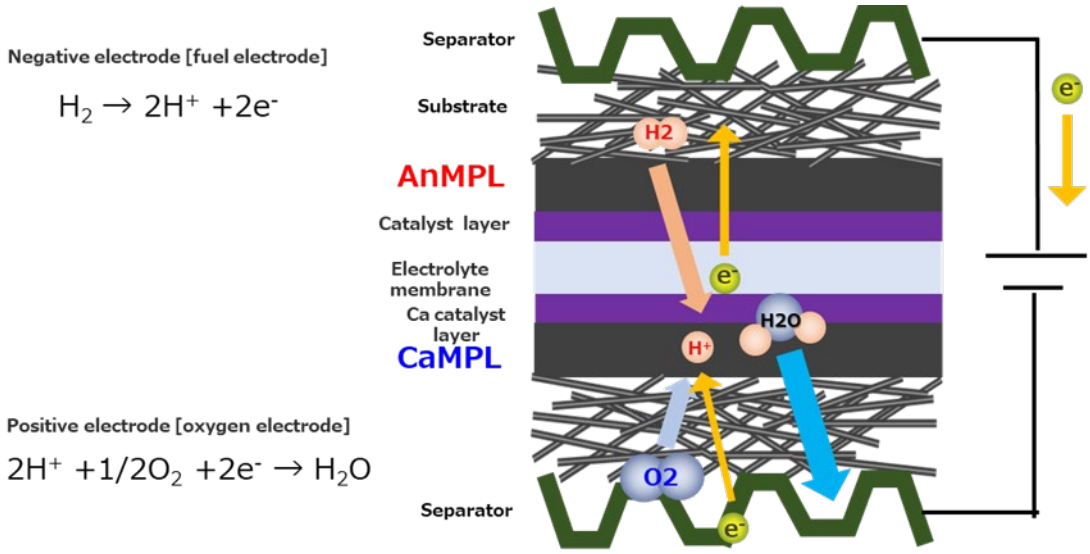


Figure fuel-cell power cell configuration

■ Concerns about substitution

Water repellency and strong acid resistance are required for MPL layers, and there is no appropriate material that satisfies all of the required characteristics other than the fluorine compound.
For example, when a fluorine compound is changed in an olefin material such as PE or PP, although it is possible to retain strong acid resistance, it is not possible to impart water repellency, and clogging due to drying of an electrolyte membrane and generated water of a gas diffusion layer occurs, resulting in remarkable deterioration in power generation performance and durability.
Further, when the fluorine compound is changed to a silicon-based water-repellent material, a decrease in the strong acid resistance property is generated, so that the water repellency performance of the micropores of MPL layer cannot be retained, and as in the case of using an olefinic material, it is blocked by the drying of the electrolyte membrane and the generated water of the gas diffusing layer, so that the power generation performance and the durability are remarkably lowered.
Therefore, when the fluorine compound cannot be used in the power generation

cell, the drying of the electrolyte membrane or the blockage of the gas diffusion layer due to the generated water causes a significant decrease in the power generation performance and durability, and the performance deterioration due to the stoppage of the fuel cell vehicle or a decrease in the power generation efficiency In addition, the ignition risk of the positive electrode and the negative electrode due to the deterioration of the electrolyte membrane becomes high due to an electrical short circuit, and there is a concern that the safety is deteriorated, so that a low-pollution vehicle cannot be spread in the future.

Application: Air Conditioning

- Product Examples

Air conditioning systems for automobiles, battery temperature control systems, etc.

- Concerns about substitution

In the first position paper (Part17, 4413) submitted by us JAPIA on June 1st, 2023, we input that it requires at least 5 years to develop new automotive air conditioning systems (hereinafter referred to as Mobile Air Conditioning Systems (MAC systems)) for an appropriate alternative refrigerant after selecting the alternative refrigerant, as extracted from the 1st comments below. We also provided an opinion that it is realistic to establish separate transition periods for new models (new vehicle types) and new vehicles (new registration vehicles) respectively because adequate transition period is necessary due to application process (e.g. application design, safety evaluations, etc.), which takes a couple of years for each vehicle model normally, for installing the developed MAC systems into each vehicle models before placing the vehicles on the market.

(Extracted from first position paper)
After selecting an appropriate refrigerant, we believe that at least 5 years of technological development will be required. In order to install the refrigerant in all automobiles and place on the market, we believe that it is realistic to apply the refrigerant to new models and new vehicles separately.

In this second position paper, we provide our comment that the separate transition periods for new vehicle types and new registration vehicles, which are proposed in

“Mobile Air Conditioning” section of European Automobile Manufacturers' Association (ACEA) comments (Part 13, 4276), is realistic. Therefore, we support those ACEA proposed transition periods.

In addition, we request unlimited derogation for MAC systems with mechanical compressors since there is no viable non-PFAS alternative refrigerant for the MAC systems.

Applications: Power Storage Devices

■ Product Examples

Backup power supply
PGB (Power Gold capacitor Backup)

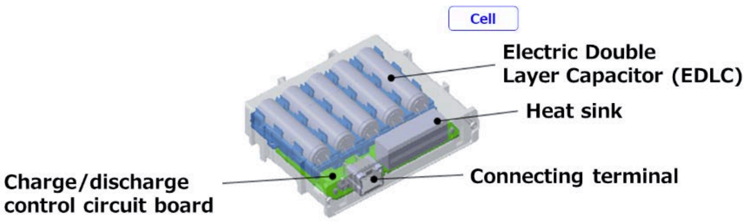


Figure PGB appearance (left) and module configuration overview (right)

■ Necessity of using PFAS

Power Gold capacitor Backup (PGB) is a power storage device that utilizes the characteristics (fast charge/discharge/high reliability) of an electric double layer capacitor (EDLC), and is used as a backup power source in the event of a vehicle power failure. Electric double-layer capacitors are the best way to ensure high capacity current without using batteries, and are used in many parts of automobiles, such as electric accelerators, electric brakes, electric shifts, parking brake, automatic driving systems, electric steering, and door locks (as shown in the figure below).

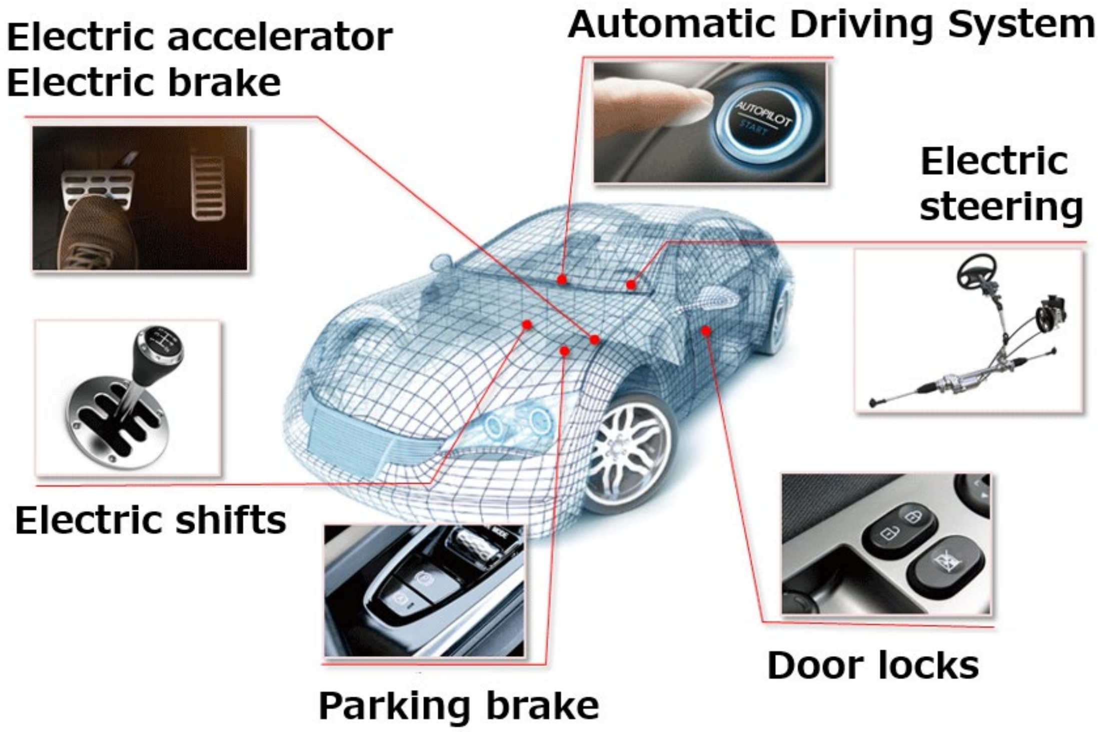


Figure Examples of use in automotive applications

The necessity of PFAS is explained below by use site/application.

1. Electrode binder for electric double layer capacitor (EDLC)

PTFE is characterized by its superior chemical and heat resistance compared to general-purpose resins. At the site of the electrode foil during EDLC production, PTFE acts as a binder for bonding activated carbon to each other and activated carbon to aluminum foil. As shown in the electrode foil configuration in figure below, the PTFE fibers are tied together to entangle activated carbon particles, resulting in a highly durable electrode with increased mechanical strength. There is no alternative material that meets the required performance equivalent to PTFE, such as chemical stability, electrochemical oxidation/reduction durability, and heat resistance, and it is an essential material for EDLC.

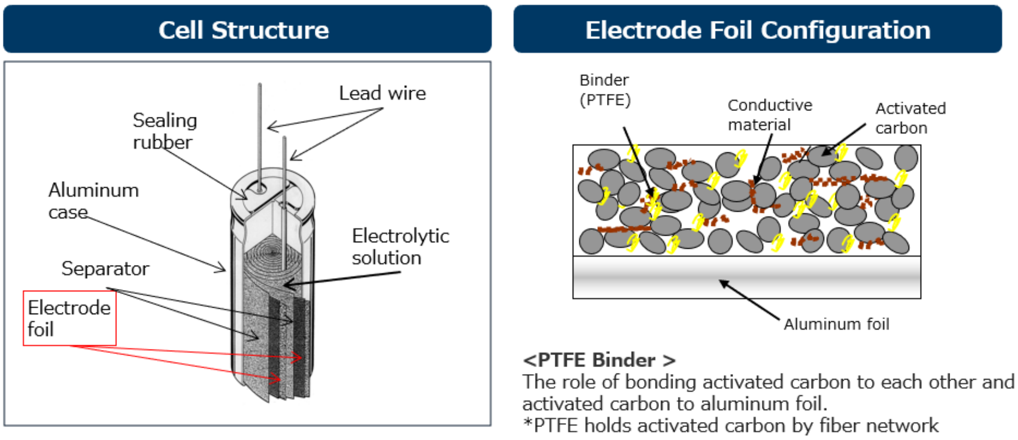
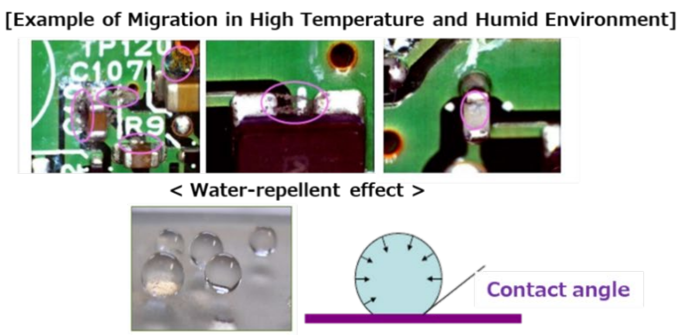
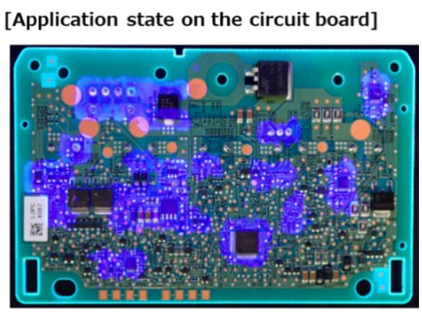


Figure Cell structure and electrode foil configuration of electric double layer capacitor (EDLC)

2. Fluorine coating for securing moisture resistance of charge/discharge control circuit board in backup power supply

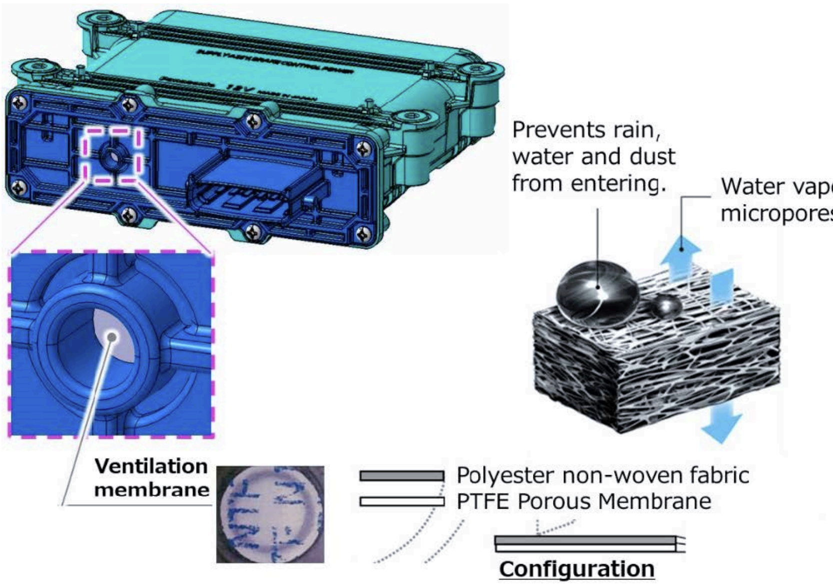
Fluorine coating agent has excellent anti-migration effect in high temperature and high humidity environment due to its water-repellent effect, and it is an essential material to secure moisture resistance of charge/discharge control circuit board. The coating to the board is a thin film (3 μm or more) and has a migration resistance effect (moisture prevention effect), thereby reducing the amount of coating agent used. Furthermore, fluorine coating agents have excellent safety due to their non-flammability and fast drying characteristics, so they do not require a drying process. They are also excellent materials from the viewpoint of productivity.





3. Ventilation membrane for achieving both breathability and moisture-proof property of Automotive Module

The backup power supply module for automotive use is a fully waterproof module. However, if the module is sealed and covered with a casing for a fully waterproof configuration, the casing may expand and contract due to changes in surrounding temperature, thereby impairing the waterproof performance and degrading the sealing material. In order to prevent this, it is essential to install a ventilation membrane that prevents water from entering and allows only air to pass through. The PTFE porous membrane is used for this ventilation membrane, and it is an essential material for achieving both breathability and moisture resistance of the module housing.



■ Concerns about substitution

Although it is an essential material for ensuring the mechanical strength and durability of EDLC cell electrode foils, there is no alternative material that meets the required performance of chemical/electrical stability/heat resistance.
Fluorine coating is described in other chapters as having multiple functions. However, it is an essential material for ensuring the moisture-proof properties of charge-discharge control circuit board, and there is no alternative material from the viewpoint of safety (flammability/toxicity) and productivity during manufacturing. As an alternative, moisture-proofing agents containing organic solvents exist, but they cannot be used as alternative materials from the viewpoint of productivity due to the large amount of use and safety (Flammable, toxic) issues. If we were to

switch to organic solvent-based coatings, we would need to invest heavily in additional drying processes and equipment, as well as line expansion due to reduced production efficiency, which could adversely affect energy consumption and CO_2 emissions.
The PTFE used in the ventilation membrane of the module is an essential material for both air permeability and moisture resistance of the module enclosure, and there is no substitute material from the viewpoint of water resistance/air permeability/method (ultrasonic welding).

As described above, various technologies that take advantage of the superior performance of PFAS are used in various parts of the backup power supply. However, there is currently no substitute material in terms of technology, quality, and manufacturing.

Applications: Film Capacitor

■ Product Examples

Film capacitor.

■ Necessity of using PFAS

Film capacitors are capacitors that use plastic films as dielectrics and are widely used in consumer electronics, measuring equipment, medical devices, photovoltaics, mobile phones, etc. They are also one of the electronic components that are being increasingly adopted for automotive applications due to the electrification of automobiles. They are used in many parts of automobiles such as drive inverters, DC/DC converters, chargers, electric air conditioner, and noise suppression (as shown in figure below).

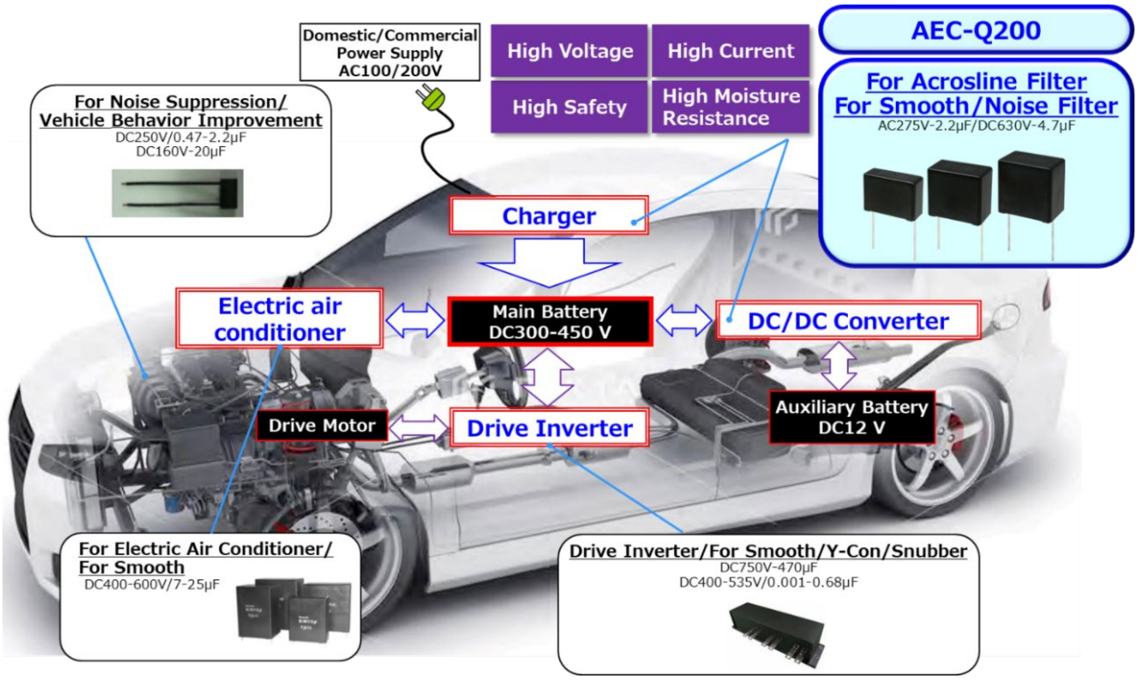


Figure Example of film capacitor use in automotive applications

For film capacitors, it is necessary to separate the deposited electrodes with a "pattern margin" and install an internal electrode pattern (fuse) to protect against overvoltage and overcurrent, and to install an "insulation margin" to ensure insulation between different electrodes, and perfluoropolyether (PFPE) is used in the manufacturing process when these margins are formed (as shown in figure below).

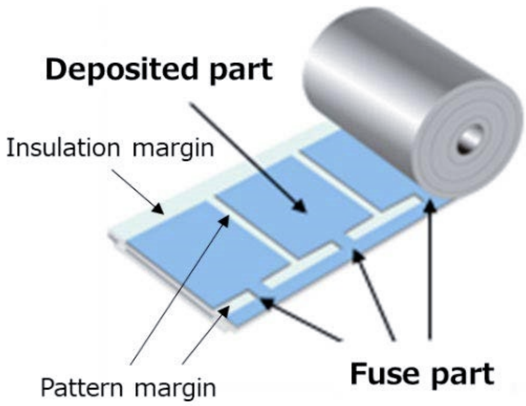


Figure Internal electrode structure of film capacitor

This fuse is indispensable for the safety function of film capacitors. When a local breakdown occurs, the fuse breaks due to a short-circuit current, and the cell where the breakdown occurs due to the breaking of the fuse is electrically cut off from other cells to maintain the overall function of the capacitor (refer to figure below). In the electrification of automobiles, the use of high voltage is increasing, so the safety function of fuses will continue to be required for film capacitors.

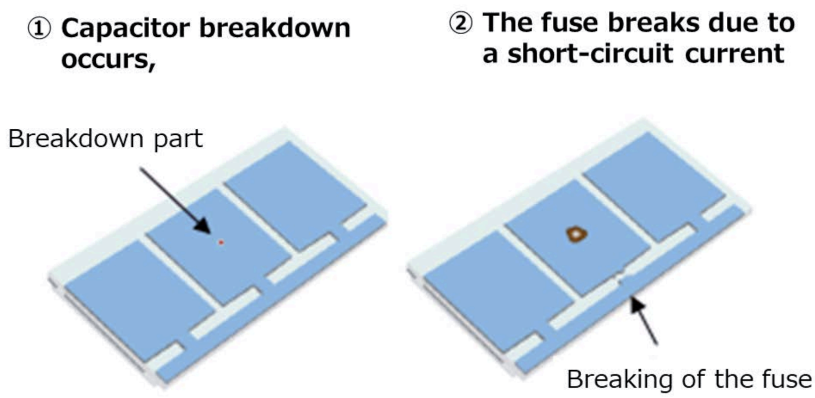


Figure Safety function of film capacitor by fuse

To form a fuse, PFPE oil is deposited on a plastic film (oil masking with PFPE), followed by metal deposition. Because no metal is deposited in the oil-masked area, fuses and insulation margins are formed. It is necessary to make the area without metal deposition as thin as possible because it becomes a loss part without generating capacitance. In addition, since the fuse part must be formed as thin as possible in order to enhance the operability, the dimensional accuracy of the order of 0.01 mm is required for oil masking by PFPE (refer to figure below). This technology can only be achieved with highly water-repellent/oil-repellent fluorinated compounds, and no other useful alternative materials exist.

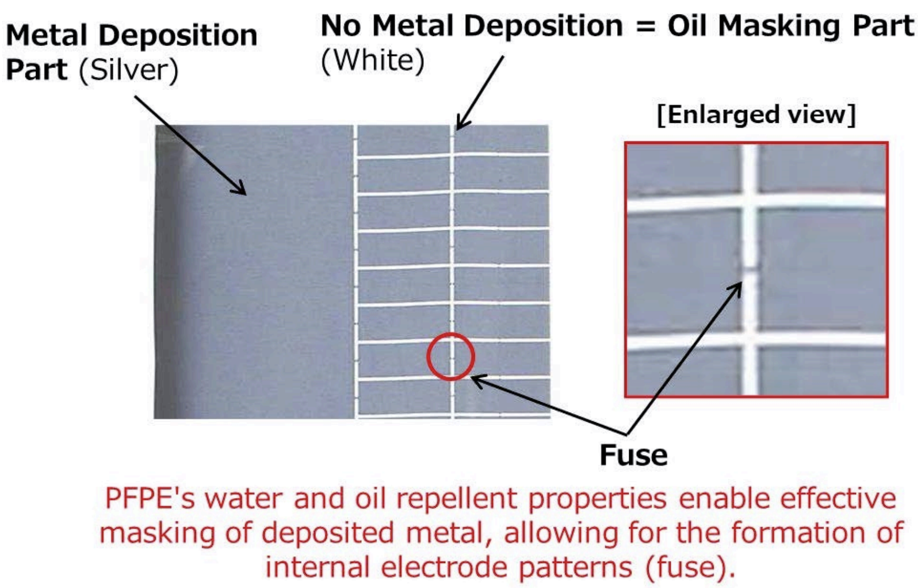


Figure External view of the internal electrode pattern (fuse)

- Concerns about substitution

Fluorinated compounds that can be substitutes for PFPE cannot be substituted because PFAS is an alternative candidate. In addition, although the PFAS restriction proposal lists PCTFE as an alternative to PFPE, PCTFE also falls under PFAS and is inconsistent with the restriction proposal itself and cannot be an alternative to PFPE. Fluorosilicone is also considered as an alternative candidate in REACH's PFAS restriction proposal, but fluorosilicone is also not an alternative to PFPE because of the low oil masking performance of deposited metal and the inability to form internal electrode patterns (fuses) with high accuracy.
Mineral oils other than PFPE have also been considered for substitution. However, since the oil masking performance of deposited metals is low in non-fluorine-containing mineral oils and internal electrode patterns (fuses) cannot be formed, there is currently no prospect of technology or materials to replace the oil masking performance of PFPE.
For the above reasons, not allowing the use of PFPE in the production of film capacitors will not only make it impossible to ensure quality of the film capacitor, but will also make it difficult to manufacture components (drive inverters, DC/DC converters, etc.) that mount these film capacitors. These components are essential for today's environmental-friendly vehicles (HEVs, PHEVs, and EVs), and there is no

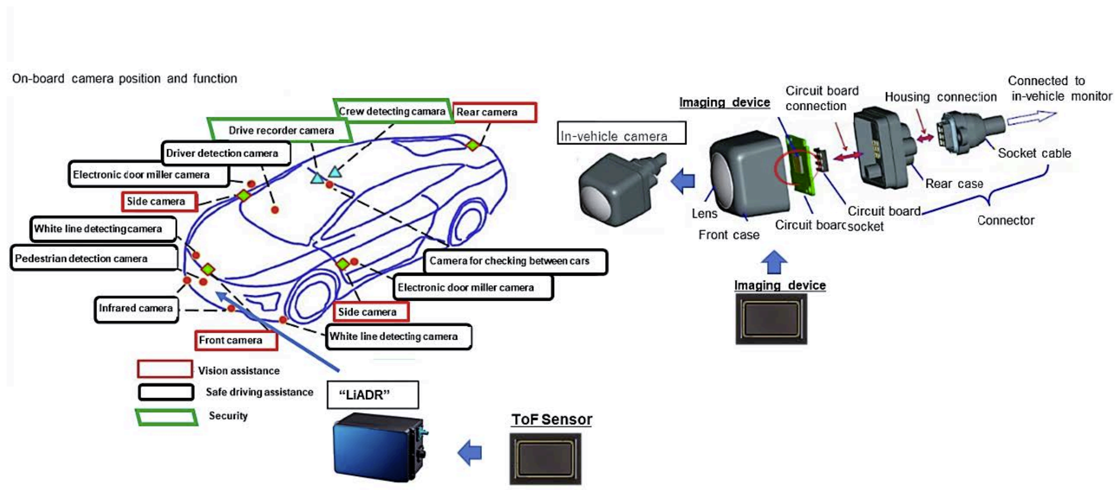
doubt that the need for these components will further increase in the future for even lower fuel consumption and for electrification. Therefore, we hope for a 12 years derogation for this application as well.

Applications: Semiconductor

Regarding to this "Semiconductor" applications, we endorse the comments (part 18, 4449) submitted by ESIA (European Semiconductor Industry Association).

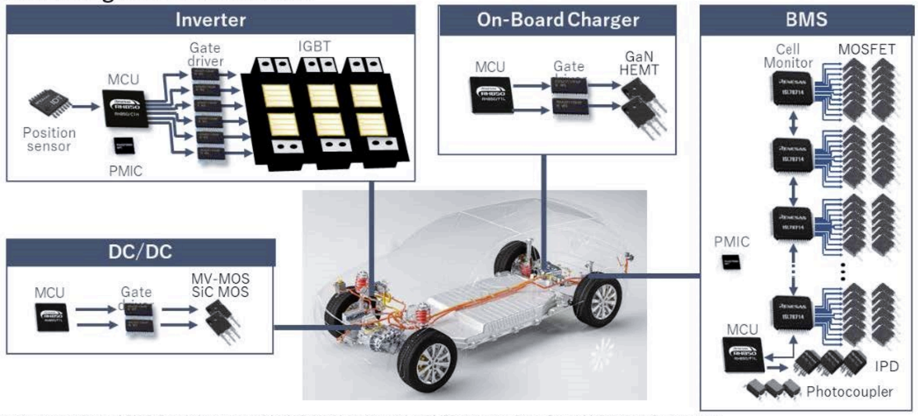
■ Product Examples

Semiconductors are used in various applications across industries. We are convinced that it is not necessary to mention now that there are many components in vehicles that are also equipped with semiconductors, and that these components are essential for the car to function.
The following are examples of semiconductor components used in vehicles (please note that these examples are not a semiconductor component containing PFAS).



Provided by Japan Jisso Technology Roadmap 2019

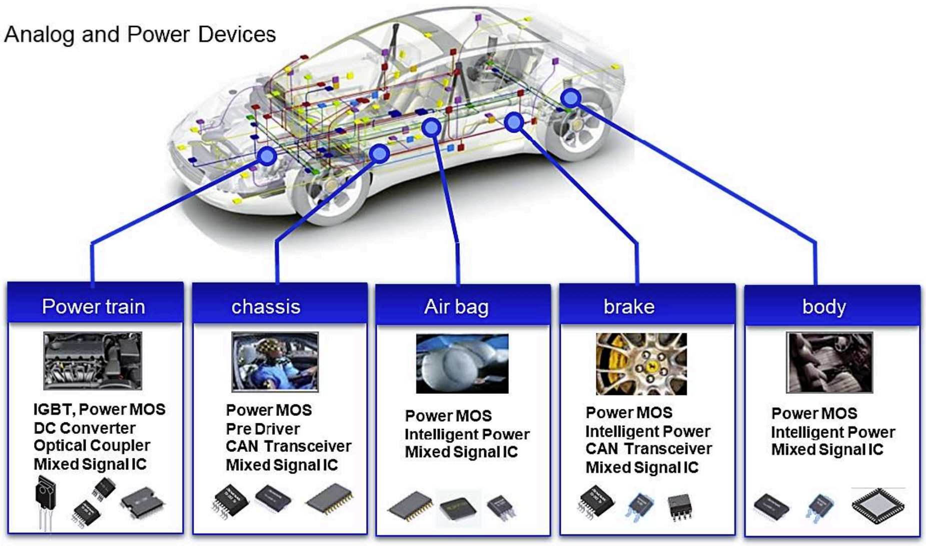
Automotive Analog and Power Devices



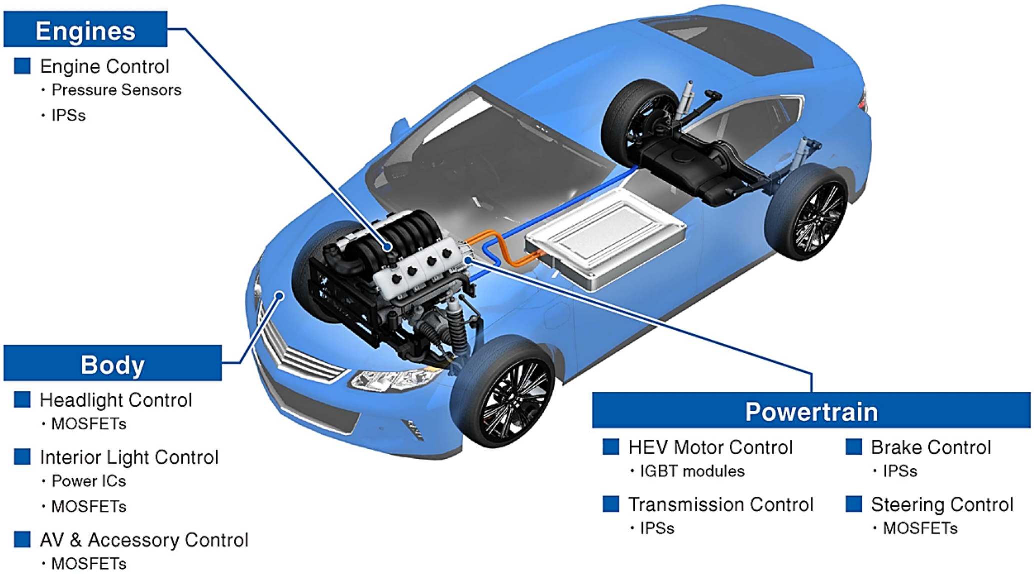
BMS: Battery Management System | PMIC: Power Management IC | MMIC: Monolithic Microwave IC | IPD: Intelligent Power Device | MCU: Micro Controller Unit

Provided by Renesas Electronics Corporation

Automotive Analog and Power Devices



Provided by Renesas Electronics Corporation



■ Necessity of using PFAS and concerns about substitution

As we mentioned semiconductor is used in a wide variety of auto parts and auto components, PFAS has been found to be used in the following semiconductor manufacturing processes. Restrictions on the use of PFAS in the semiconductor manufacturing process would mean that semiconductors could no longer be manufactured. For more information, please refer to the semiconductor sector's comments above, and here is an example of the concerns raised by the loss of the use of PFAS in the semiconductor manufacturing process.

1. Etching process
Fluorinated gas, which is a part of PFAS, is used as dry etching gas.
It is an essential substance in the manufacture of silicon semiconductors and cannot be replaced by other substances.

2. Cooling refrigerant to keep wafer temperature down (precision temperature control)

3. Photolithography
The unique and diverse characteristics of PFAS, such as photoacid generators (PAGs) and surfactants, are indispensable for semiconductor manufacturing. Much research is needed to obtain effective alternatives.

For example, top antireflective coatings, TARC, immersion barriers are part of photolithography where PFAS is used. There are also techniques to leave a thin film formed by photolithography in the final product, where PFAS remains in the product.

4. Materials for manufacturing equipment and factory equipment
✓ Used in fluoroelastomer in the product of vacuum sealants
(highly clean, heat resistant and plasma resistant)
✓ Used in fluoroplastic in the product of tubes, joints and valves

In the semiconductor manufacturing process, materials for manufacturing equipment and factory equipment are also indispensable to semiconductor manufacturing.
Since they have a significant impact on the manufacturing of all electronic devices,

including automobiles, medical devices, social infrastructure equipment and so on that use semiconductor products containing PFAS, it is also necessary to consider the impact on the entire semiconductor supply chain.
Currently, there is no effective means of replacing PFAS used in the manufacture of high-performance semiconductors, and there is no doubt that long derogation period is needed for the research and development of alternatives.

Without Derogation, semiconductor manufacturing would not be able to continue to supply these semiconductors to the automotive industry. In order to avoid disruption on a global scale and not to hinder sound product manufacturing and product development, we strongly request the derogation of paragraph 5 ee "the semiconductor manufacturing process until 13.5 years after EiF". In addition, since there are many PFAS products for which there is no prospect of alternatives at this time, it is fully expected that there will be worst cases where alternatives cannot be found even with an additional 12 years derogation period. Therefore, we would like a mechanism to apply for a derogation period of more than 12 years to be incorporated into the restrictions.
In addition, as mentioned above, semiconductors themselves are widely used in the automotive industry, and we believe that components (applications) mounted with such semiconductors are considered to be "applications affecting the proper functioning related to the safety of transport vehicles, and affecting the safety of operators, passengers or goods until 13.5 years after EiF" under the restriction "paragraph 6 o". Therefore, we believe that in addition to semiconductor processes, semiconductor products for transport vehicles are also included in the scope of derogation.

Finally, we refer to the technical papers published by the Semiconductor Industry Association (SIA). It describes in detail the impact of this restriction on the Semiconductor Sector. So please refer to the following website for further information.
https://www.semiconductors.org/pfas/

- The Impact of a Potential PFAS Restriction on the Semiconductor Sector
<Case Study>
- PFOS and PFOA Conversion to Short-Chain PFAS Used in the Semiconductor - Manufacturing
- PFAS-Containing Surfactants Used in Semiconductor Manufacturing
- PFAS-Containing Photo-Acid Generators (PAGs) Used in Semiconductor Manufacturing
<White Paper>
- Background on Semiconductor Manufacturing and PFAS
- PFAS-Containing Fluorochemicals Used in Semiconductor Manufacturing Plasma-Enabled Etch and Deposition

- PFAS-Containing Heat Transfer Fluids (HTF) Used in Semiconductor Manufacturing
- PFAS-Containing Materials Used in Semiconductor Manufacturing Assembly Test - Packaging and Substrate Processes
- PFAS-Containing Wet Chemistries Used in Semiconductor Manufacturing
- PFAS-Containing Lubricants Used in Semiconductor Manufacturing
- PFAS-Containing Articles Used in Semiconductor Manufacturing

■ Summary of Chapter 5

These groups of applications are still representative examples (for additional details of other applications, please refer to the revised Attachment 1 non-exhaustive list of applications). Please be aware that these are all part of the uses associated with “applications affecting the proper functioning related to the safety of transport vehicles, and affecting the safety of operators, passengers or goods until 13.5 years after EiF” in paragraph 6 o in the draft restriction.

Even now that we have completed additional research for this second position paper, with the exception of refrigerants for MAC system, no alternative technologies or materials have been identified, nor is there a clear path forward for their development. Therefore, we, JAPIA, strongly insist on the decision of the 12 years derogation period in “Paragraph 6 o”, which had been re-discussed after the Public Consultation (this claim remain the same as in the first position paper). Even if alternative technologies or materials are ready, there will be a period for us, the component manufacturer, to verify the safety and reliability of the alternative components for each tremendous number of products, and a period for the automobile manufacturers, the downstream users, to verify them as automobiles, and even after the acceptance is confirmed in both cases, there will be a necessary transition period to switch over. Considering that a necessary transition period is required, even if there is a 12 years derogation period, we, who are responsible for ensuring a reliable switchover, feel very uneasy. The key question is when will alternative technologies or materials be ready. But we do not know when they will be available at this time. Therefore, what we would like to propose is to add a "review clauses" to the proposed restriction that would allow for an extension of the derogation period if suitable alternative technologies or materials are not ready by a given date (The content of this claim is also unchanged from the first position paper). As you know, this has a practical example in the derogation of lead in copper alloys in the EU RoHS Directive, and we would appreciate your consideration of a research project similar to Pack 22 and the possibility of a review and possible extension decision by the EU Commission.

6. Environmental release of PFASs

In the first position paper, we described the percentage of waste left in the environment related to the risk of environmental releases during the disposal/recycling phase of vehicles (including auto parts). It has been found that the risk of release to the atmosphere, soil, and water (rivers and oceans) due to landfill is very small.

In this second position paper, we present the results of an actual evaluation of the migration of PFAS into water by an external evaluation organization with respect to parts containing PFAS.
This assessment assumes the risk of release upon contact with water while the vehicle is in motion (use phase of the parts), during disposal, and after landfill.

<Test Methods>
Migration testing into water was conducted using fluoroplastic and fluoroelastomer based parts. The basic test method is based on Migration Testing in Annex XV restriction report E7.1.3 of BPA.

- Testing Parts
  sample A : ring shaped seal part (PTFE)
  sample B : ring shaped seal (FKM)
- Solvent
  Hot water at approx. 95°C
- pH
  pH 5-6 (assuming outdoor use)
- Extraction time
  1 hour, 3 times repeated extractions (Test 1, 2, 3)
- Number of samples tested
  n=3
- Analyte
  Total fluorine
- Analysis method
  EN 14582:2016
  Oxygen combustion in closed systems and determination methods

- Analysis equipment

  Ion chromatography

The solvent temperature was set at approx. 95 degrees, close to the boiling point of water, to make extremely harsh environment that is considered to be at maximum extraction, although a temperature of approx. 25 degrees is considered appropriate, assuming that the target parts becomes shredder dust.

<Results>

Sample A (PTFE)

Test 1 : 50 mg/L or less (below the limit of quantification)
Test 2 : 50 mg/L or less (below the limit of quantification)
Test 3 : 50 mg/L or less (below the limit of quantification)

Sample B (FKM)

Test 1 : 50 mg/L or less (below the limit of quantification)
Test 2 : 50 mg/L or less (lower limit of quantification)
Test 3 : 50 mg/L or less (below the limit of quantification)

As shown above, both Samples A and B showed results below the lower limit of quantitation for Test 1 through Test 3, which were repeated extractions, and the results were the same for both N=3 measurements.

Even in environment where it is assumed that the samples come in contact with or are immersed in hot water at about 95 degrees, no migration into water can be confirmed.
Even in extremely harsh environment where contact or immersion in hot water at approx. 95 degrees is assumed, there is no evidence of migration into the water.
Unfortunately, due to the limitations of this test method, absolute values could not be determined, but there is no evidence of PFAS migration when parts containing PFAS come into contact with hot water, whether during vehicle operation, disposal processes, or in landfill.

It is undeniable that this test is only at the verification phase while the test method and test conditions have not been finalized, and we hope that a reliable test method will be clarified. Since data on such releases is extremely important information in verifying effective and efficient regulatory coverage, we expect that the content of test results submitted by material manufacturers, analytical laboratories, and various industries will be carefully verified during future public consultation of PFAS.

As an additional test, we would like to share with you the results of a qualitative analysis of a Fluoroplastic (PTFE)-based part (O-ring), assuming its release to the environment during the use phase of the part (during the use of the vehicle). In this test, Sample A, which was used in the migration test to water mentioned above, was used. The sample was heated in a heating furnace and the gases generated were analyzed by gas chromatography mass spectrometry (TD-GC/MS).

The heating conditions in the heating furnace are 280 degrees for 10 min. The rationale for this temperature setting is explained below. First, we assumed that parts in close proximity to the high-temperature parts of an engine compartment will reach a temperature of 120 degrees. Next, we assume that the car will be used for 20 years. The average driving time per day is assumed to be 1.3 hours based on the result of the NITE (National Institute of Technology and Evaluation, Japan) survey on automobile driving time. Then, the lifetime driving time of a car would be 9490 hours. However, it was not realistic to conduct the evaluation at 120 degrees for 9490 hours, and it was also necessary to consider the conditions under which the GC/MS equipment could perform the measurement. On the other hand, acceleration conditions at higher temperatures than necessary are inappropriate for environmental release testing because of the risk of decomposition of fluoropolymers. Therefore, we decided to establish alternative acceleration conditions equivalent to 9490 hours at 120 degrees. Considering the above, using the rule of thumb that 10 degrees increase in temperature doubles the degradation, a test condition of 280 degrees for 10 min was set as the test condition assuming the emitted amount during lifetime driving of a vehicle.

The results confirm that no PFAS were detected. This result is one case study. It shows that the risk of environmental emission of PFAS is extremely low in PTFE, which is used in many auto parts. Although all PFASs are currently regulated in the same way, we hope that the proposed restrictions will be effective and efficient by reconsidering the appropriate scope of regulation and exemption/derogation according to the risk of environmental emission.

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Technical Department
Japan Auto Parts Industries Association