Product Safety Assessment

DOW™ Photoresists and Anti-Reflectants (non-PFOS)


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Names
- AR™ Series DUV Anti-Reflectants
- EAGLE™ Series Photoresists
- MICROPOSIT™ Series Photoresists
- SL™ Series Positive DUV Photoresists
- SiBER™ Series DUV Underlayer
- UV™ Series Positive DUV Photoresists
- CAS No. 628-63-7, Amyl Acetate
- CAS No. 100-66-3, Anisole
- CAS No. 123-86-4, n-Butyl Acetate
- CAS No. 97-64-3, Ethyl lactate
- CAS No. 3852-09-3, Methyl-3-methoxypropionate
- CAS No. 108-65-6, Propylene glycol methyl ether acetate
- AR Series 193 nm Anti-Reflectants
- EPIC™ Series 193 nm Photoresists
- MEGAPOSIT™ Series Photoresists
- PHOTOPOSIT™ Series Photoresists
- SiBER Series Bilayer DUV Photoresists
- ULTRA-i™ Series i-Line Photoresists

DOW™ Photoresists and Anti-Reflectants (Non-PFOS) are liquid formulations containing high-purity solvents, acrylic or other polymer resins, and cross-linking agents. The photoresist and anti-reflectant products covered in this PSA do not contain the surfactant, perfluorooctane sulfonic acid (PFOS). For further details, see Product Description.

DOW Photoresists and Anti-Reflectants (Non-PFOS) are used in the electronics industry to manufacture integrated circuits, printed circuit boards, and other specialty electronic components. For further details, see Product Uses.

Exposure can occur either in facilities that manufacture DOW Photoresists and Anti-Reflectants (Non-PFOS) or in the various industrial or manufacturing facilities that use these products. Dow does not sell DOW Photoresists and Anti-Reflectants (Non-PFOS) for direct consumer use, but they are used as raw materials in electronics manufacturing. Consumer exposure is unlikely. For further details, see Exposure Potential.

Health information for DOW Photoresists and Anti-Reflectants (Non-PFOS) is summarized in the Safety Data Sheets, which is the preferred source for health hazard information. Eye contact with these products may cause pain, temporary irritation, and superficial tissue damage. For more information, see Health Information.
corneal injury. Brief skin contact may cause irritation. Prolonged or repeated skin contact may cause drowsiness, central nervous system depression, kidney damage, or liver damage. Inhalation may cause irritation of the nose, throat, and respiratory tract. Swallowing may cause irritation of the mouth, throat, and digestive tract, headache, nausea, and vomiting. For further details, see Health Information and request the relevant Safety Data Sheet from the Dow Customer Information Group.

- DOW™ Photoresists and Anti-Reflectants (Non-PFOS) predominantly consist of solvents. The products are readily biodegradable and not likely to accumulate in the food chain (bioconcentration potential is low). They are moderately toxic to aquatic organisms on an acute basis. For further details, see Environmental Information.

- DOW Photoresists and Anti-Reflectants (Non-PFOS) are stable under normal storage and use conditions. Liquid and vapor are flammable for some products; combustible for others. Products can decompose under high temperatures. Avoid contact with oxidizing agents, strong acids, strong bases, and reducing agents. For further details, see Physical Hazard Information.

Manufacture of Product

- **Capacity** – DOW™ Photoresists and Anti-Reflectants (Non-PFOS) are produced by Rohm and Haas, a wholly owned subsidiary of The Dow Chemical Company, and its global affiliates in facilities located in Japan, Korea, and in the United States.

- **Process** – DOW™ Photoresists and Anti-Reflectants (Non-PFOS) are produced by combining one or more electronics-grade solvents with proprietary polymer resins, cross-linking agents, stabilizers, and/or surfactants.

Product Description

DOW™ photoresists and anti-reflectants are formulated by Rohm and Haas, a wholly-owned subsidiary of Dow. Photoresists are typically red amber liquids, but sometimes they are colorless, brown, blue, or yellow. Anti-reflectants are colorless or light yellow liquids. Photoresists and anti-reflectants are solvent-based solutions containing mixtures of highly pure solvents, acrylic or other polymer resins, and cross-linking agents, stabilizers, and/or surfactants. The products covered in this PSA do not contain perfluorooctane sulfonic acid (PFOS) derived surfactants or cross-linkers.

DOW photoresists and anti-reflectants are packaged in a variety of container options that most commonly include 1-liter and 1-gallon bottles. For circuit board applications, we offer photoresists in 1-liter, 5-liter, 5-gallon, and 20-liter bottles/jerricans.

Product Uses

DOW™ Photoresists and Anti-Reflectants (Non-PFOS) are used in the electronics industry to manufacture microelectronics-integrated circuits (e.g., transistors, capacitors, inductors, resistors, diodes), printed circuit boards, and other specialty electronic components. In the microlithography process, photoresists are spun-coated onto silicon wafers and dried to a film. A circuit image is then created on the film, usually by exposure to UV light. After further drying, the exposed film is removed by an alkaline solution during a developing step and an etching process removes the desired amount of silicon from the developed areas (while the remaining silicon areas remain protected by the photoresist). A stripping process removes all remaining photoresist material from the wafer. An exact image of the circuit has been etched into the silicon wafer. After metal deposition and further processing, the silicon wafers are diced into rectangular semiconductor chips.
Exposure Potential

DOW™ Photoresists and Anti-Reflectants (Non-PFOS) are used in the production of electronic products. Based on the intended uses of these products, individuals could be exposed through:

- **Workplace exposure** – Exposure can occur either in facilities that manufacture DOW Photoresists and Anti-Reflectants (Non-PFOS) or in the various industrial or manufacturing facilities that use these products. It is produced, distributed, stored, and consumed in closed systems. Those working with DOW Photoresists and Anti-Reflectants (Non-PFOS) in manufacturing operations could be exposed during maintenance, sampling, testing, or other procedures. The potential for exposure is minimal because quality control requires separation of products from workers during manufacturing and packaging. These products have high precision and low tolerance for contamination. The tools and handling practices used in production are designed to prevent direct worker contact with the photoresists and anti-reflectants. Each manufacturing facility should have a thorough training program for employees and appropriate work processes, ventilation, and safety equipment in place to limit exposure. See Health Information.

- **Consumer exposure to products containing DOW Photoresists and Anti-Reflectants (Non-PFOS)** – Dow does not sell DOW Photoresists and Anti-Reflectants (Non-PFOS) for direct consumer use, but they are used as a raw material in electronics manufacturing during the wafer lithographic process, and removed afterwards. No photoresist is present on the finished components, so consumer exposure is unlikely. See Health Information.

- **Environmental releases** – In the event of a spill, the focus is on containing the spill and preventing contamination of soil and surface water or ground water. Respiratory protection is necessary during cleanup of up spills and leaks. Ignition sources should be removed immediately. For a small spill, the product may be absorbed with inert material like sand or soil. The solvent portion of the products has a low acute toxicity to aquatic organisms. See Environmental, Health, and Physical Hazard Information.

- **Large release** – Industrial spills or releases are infrequent and generally contained. If a large spill does occur, the product should be captured, collected, and reprocessed or disposed of according to applicable governmental requirements. Wear suitable protective clothing and respiratory protection. Eliminate all ignition sources. Prevent the material from entering drains or water courses and do not discharge directly to a water source. Advise authorities if spilled material enters a water course or sewer or contaminates soil or vegetation. See Environmental, Health, and Physical Hazard Information.

- **In case of fire** – Deny any unnecessary entry into the area and consider the use of unmanned hose holders. Use water spray or fog, carbon-dioxide or dry-chemical extinguishers, or foam to fight the fire. Keep containers and surroundings cool with water spray. This product may produce hazardous vapors in a fire. Pressure may build up in closed containers producing combustible vapors. Vapors can travel to a source of ignition and flash back. Wear full protective clothing and self-contained breathing apparatus (SCBA) to fight the fire. See Environmental, Health, and Physical Hazard Information.

For more information, request the relevant Safety Data Sheet from the Dow Customer Information Group.

Health Information

Health information for DOW™ Photoresists and Anti-Reflectants (Non-PFOS) is summarized on the relevant Safety Data Sheets. These materials may also contain minor components or additives that have additional health risks. It is important to note that health risks associated with individual products may vary based on their formulation or intended use. The Safety Data Sheet is the preferred source for specific health information. An overview of health information for DOW Photoresists and Anti-Reflectants (Non-PFOS) appears below.

- **Eye contact** – Contact may cause pain, transient irritation, and superficial corneal injury.

- **Skin contact** – Brief contact may cause irritation. Prolonged or repeated exposure may cause drowsiness, defatting and drying of the skin, irritation and dermatitis, central nervous system depression, and kidney or liver damage. Prolonged or repeated contact may lead to absorption of harmful amounts.

- **Inhalation** – Inhalation may cause irritation of the nose, throat, and respiratory tract. Higher concentrations may cause systemic effects similar to those of ingestion.

- **Ingestion** – Swallowing may cause irritation of the mouth, throat, and digestive tract, headache, nausea, and vomiting. Repeated doses may cause central nervous system depression, liver and kidney damage.
Environmental Information

Environmental information for DOW™ Photoresists and Anti-Reflectants (Non-PFOS) is summarized on the relevant Safety Data Sheets. These materials may also contain solvents or additives that have additional environmental impact. It is important to note that environmental impact associated with individual products may vary based on their formulation or intended use. The Safety Data Sheet is the preferred source for specific environmental information. An overview of environmental information for DOW Photoresists and Anti-Reflectants appears below.

DOW Photoresists and Anti-Reflectants (Non-PFOS) consist primarily of solvents (80% of the product composition), including various combinations of amyl acetate, anisole, n-butyl acetate, ethyl lactate, methyl-3-methoxypropionate, propylene glycol monomethyl ether, and propylene glycol methyl ether acetate. If released, some of these materials may volatilize from soil or water. These products are not likely to accumulate in the food chain (bioconcentration potential is low). They are moderately toxic to aquatic organisms (LC50 of 1 mg/L to 10 mg/L in the most sensitive species tested).

During the production of electronics, a majority of the photoresist and anti-reflectant products are applied to silicon wafers which results in nearly 97 percent of the original product spinning off the wafer and being captured as waste for off-site incineration. The portion that remains on the silicon wafer is converted from liquid to a film during a solvent evaporation step (baking step). This dry film contains the non-volatile acrylic polymers, crosslinkers, surfactants, stabilizers and other additives. Roughly half of the coated film on each wafer is dissolved during a developer step that is similar to conventional photograph development. These dissolved ingredients are later neutralized in wastewater treatment processes and discharged to the aquatic environment. Any film remaining on the silicon wafer is removed by solvent wash in later steps and ultimately incinerated. This process is similar for the manufacture of circuit boards.

Most of the ingredients that are dissolved during the development step are not readily biodegradable. Designed to be light sensitive, they will fragment upon contact with sunlight.

Physical Hazard Information

DOW™ Photoresists and Anti-Reflectants (Non-PFOS) are stable under normal storage and use conditions, but can decompose at high temperatures. The solvent portion makes these products combustible or flammable. Vapors may travel a long distance and are an explosion hazard. Store away from direct sunlight and minimize sources of heat, spark, or fire. Avoid static discharge.

Avoid contact with oxidizing agents, strong acids, strong bases, and reducing agents.

Regulatory Information

Regulations may exist that govern the manufacture, sale, transportation, use, and/or disposal of DOW™ Photoresists and Anti-Reflectants (Non-PFOS). These regulations may vary by city, state, country, or geographic region. Information may be found by consulting the relevant Safety Data Sheet, Technical Data Sheet, or Contact Us.

Additional Information

- Safety Data Sheet (request from the Dow Customer Information Group at www.dow.com/assistance/dowcig.htm)
- Contact Us (www.dow.com/assistance/thoughts.htm)
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- AR™ Organic Bottom Anti-reflectants
- ArF (193 nm) Photoresists (dry and immersion) / EPIC™ Photoresist

For more business information about DOW™ Photoresists and Anti-Reflectants (Non-PFOS), visit the Dow Electronic Materials website at www.dowelectronicmaterials.com/products/semiconductors/litho.htm

References
NOTICES

As part of its 2015 Sustainability Goals, Dow has committed to make publicly available safety assessments for its products globally. This product safety assessment is intended to give general information about the chemical (or categories of chemicals) addressed. It is not intended to provide an in-depth discussion of health and safety information. Additional information is available through the relevant Safety Data Sheet, which should be consulted before use of the chemical. This product safety assessment does not replace required communication documents such as the Safety Data Sheet.

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