

Flowable Oxides

Information About *FOx*[®]-1x and *FOx*-2x Flowable Oxides

FEATURES

- State-of-the-art planarization
- Low dielectric constant
- Controlled film thickness
- Excellent gap fill
- Very low defect density
- Choice of carrier solvent systems

COMPOSITION

- Inorganic polymer

Spin-on dielectric material for integrated circuit fabrication.

APPLICATIONS

The characteristics of *FOx*[®] Flowable Oxide make it an ideal material for use as an interlevel dielectric in multilevel metal integrated circuit designs. The material also can be used to markedly improve topside planarity when applied prior to final passivation. As supplied, *FOx* Flowable Oxide is a liquid solution of hydrogen silsesquioxane in a carrier solvent. As processed, the physical form is a spun-on flowable polymer cured to an amorphous film.

TYPICAL PROPERTIES

Specification Writers: Please contact your local Dow Corning Sales Application Engineer or Dow Corning Customer Service before writing specifications on this product.

Thickness Range, Å ¹	
<i>FOx</i> -14	2700-3500
<i>FOx</i> -15	3800-4900
<i>FOx</i> -16	5200-6700
<i>FOx</i> -17	7000-9000
<i>FOx</i> -22	2400-3300
<i>FOx</i> -23	3200-4400
<i>FOx</i> -24	4300-6000
<i>FOx</i> -25	5800-8100
Trace Metal Impurities, ppb	<10
Film Density ² , g/cm ³	1.4
Film Stress (Tensile), MPa	80-100
Dielectric Constant, 1 MHz	3.0
Film Non-Uniformity, percent RSD	<1

¹For typical spin speeds of 2000-4000 rpm.

²Typical *FOx* Flowable Oxide converted film properties, processed at 400°C (752°F) in nitrogen ambient.

DESCRIPTION

FOx Flowable Oxide is a flowable, inorganic polymer that is designed to meet industry demands for improved dielectric materials. *FOx* Flowable Oxide is a direct replacement for low-temperature CVD and SOG processes.

These materials are semiconductor grade (<10 ppb trace metals). They are available in several versions to produce a range of thicknesses up to 1.2 µm with a single coat.

A choice of carrier solvent system is also available. First-generation *FOx* Flowable Oxide (now referred to as “*FOx*-1x Flowable Oxide”) uses methyl isobutyl ketone (MIBK) as its carrier solvent, whereas second-generation *FOx*

Flowable Oxide (“*FOx*-2x Flowable Oxide”) uses a volatile methyl siloxane (VMS) fluid blend as the carrier solvent.

Both solvent systems volatilize rapidly from the resin, leaving a planar surface. Cured films from both systems are essentially identical when tested for film stress and dielectric constant, and using FTIR comparisons. (See Figure 1.)

However, unlike MIBK, the VMS fluids are exempt from federal and state regulations covering volatile organic compounds (VOCs). In addition, the *FOx*-2x Flowable Oxide products are odor-free and compatible with a broader range of plastic materials than are the *FOx*-1x Flowable Oxide products.

Semiconductor-grade MIBK and siloxane rinse solvents are available from Dow Corning as companion products. The line rinse solvents conform to the same impurity and particle specifications as the *FOx* Flowable Oxide products.

FOx-1x Flowable Oxide products include *FOx-12*, *FOx-13*, *FOx-14*, *FOx-15*, *FOx-16*, and *FOx-17*. *FOx-2x* Flowable Oxide products include *FOx-22*, *FOx-23*, *FOx-24*, and *FOx-25*.

HOW TO USE

FOx Flowable Oxide is applied using standard spin-on glass equipment. It can be spin-coated under a wide range of conditions, which will optimize uniformity on complex geometries. After spin-coating, hot plates are used not only to remove solvent as with conventional SOGs, but also to melt and flow the film. The melt and flow properties of the material help to provide superior smoothing and gap fill.

After flow, the film is cured in a standard quartz diffusion furnace. At this point, the material is ready for the next processing step. No etchback is required.

SHIPPING LIMITATIONS

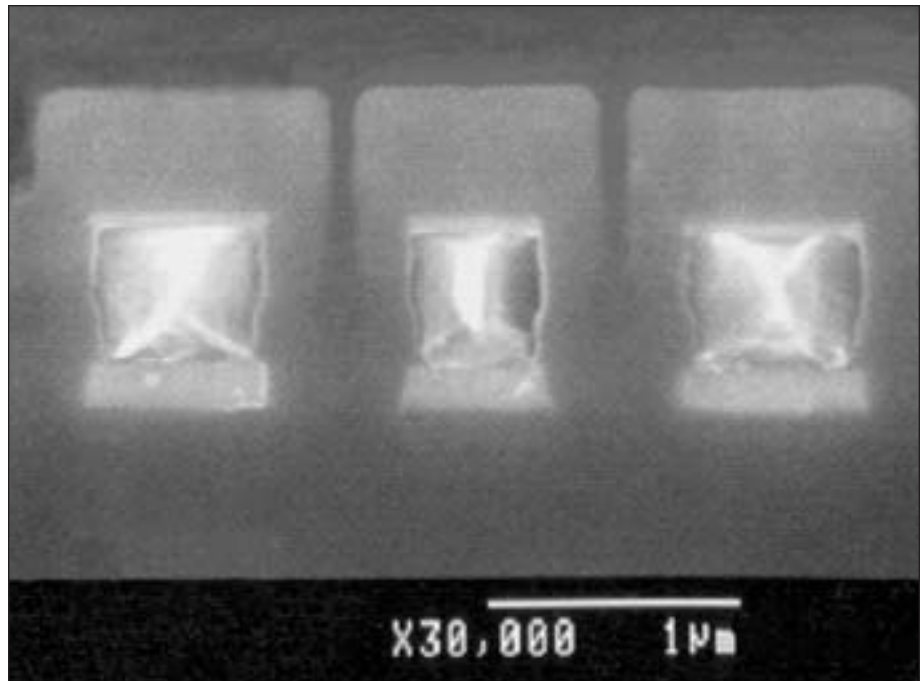
See Material Safety Data Sheet.

STORAGE AND SHELF LIFE

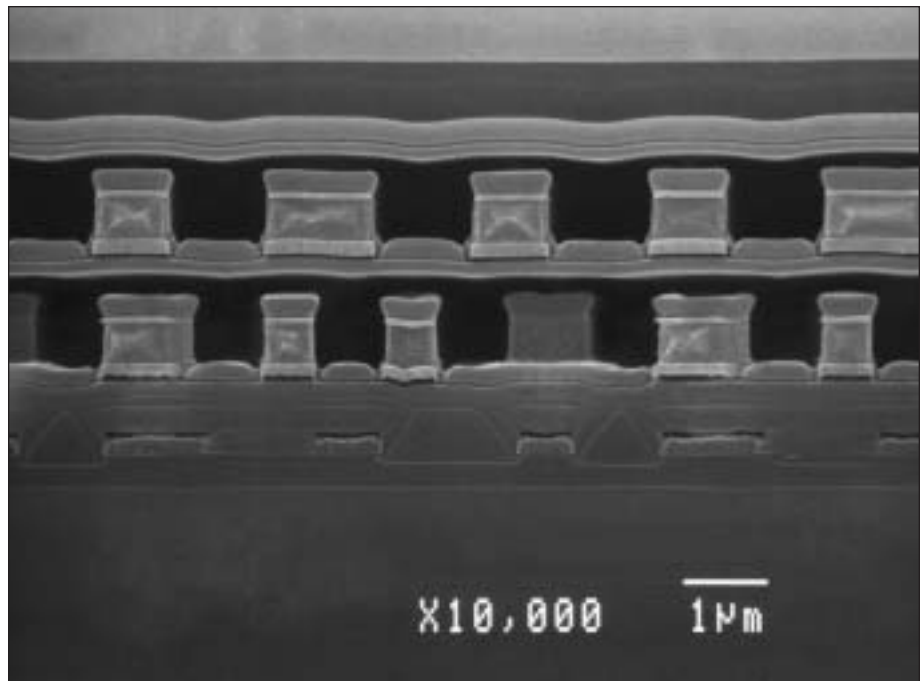
Refer to the Sales Specifications and/or Product Label for these products. These products have a shelf life of 6 months from date of manufacture.

PACKAGING

FOx Flowable Oxide is available in 250-mL, 500-mL, 1-L, 2-L, and 4-L containers.

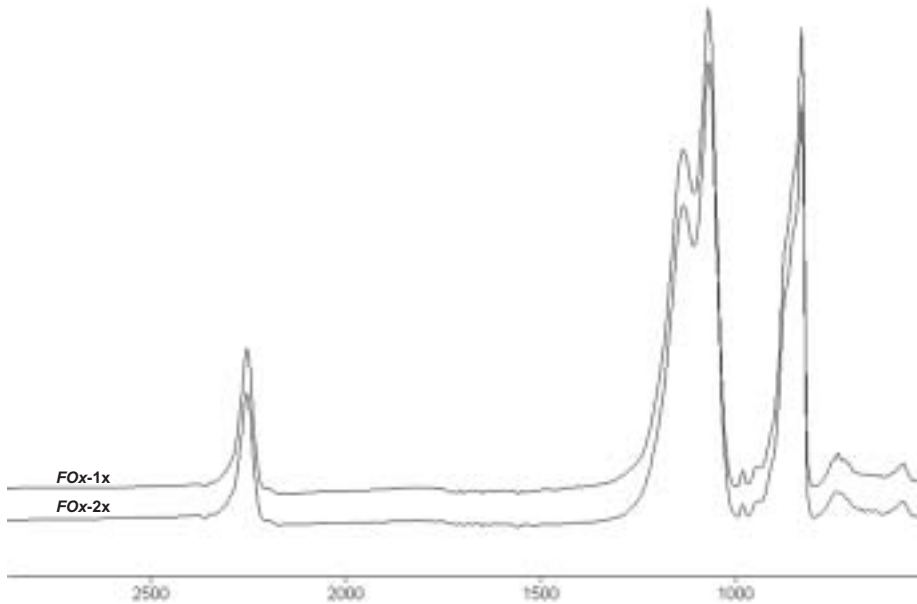


SEM cross-section of FOx Flowable Oxide gap fill capability with 800Å gap outlined.



SEM cross-section of FOx Flowable Oxide in three-layer structure.

FIGURE 1: Final Cured Film Characteristics, Measured by FTIR¹



¹Processed at 400°C (752°F) for 1 hour in a quartz tube furnace in nitrogen ambient.

PATENT POSITION

The use of *FOx* Flowable Oxide to produce electronic devices is claimed in one or more patents assigned to Dow Corning. Dow Corning intends to enforce these patents but will offer licenses hereunder. The purchase of *FOx* Flowable Oxide from Dow Corning includes a license and the royalty is paid with the purchase. A listing of the licensed patents may be obtained by calling 1-800-248-2481. Alternatively, if a written license is desired it can be obtained at a comparable royalty rate upon written request, regardless of the source of the material.

LIMITATIONS

These products are neither tested nor represented as suitable for medical or pharmaceutical uses.

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PRODUCT SAFETY INFORMATION REQUIRED FOR SAFE USE IS NOT INCLUDED IN THIS DOCUMENT. BEFORE HANDLING, READ PRODUCT AND MATERIAL SAFETY DATA SHEETS AND CONTAINER LABELS FOR SAFE USE, PHYSICAL AND HEALTH HAZARD INFORMATION. THE MATERIAL SAFETY DATA SHEET IS AVAILABLE ON THE DOW CORNING WEBSITE AT WWW.DOWCORNING.COM, OR FROM YOUR DOW CORNING REPRESENTATIVE, OR DISTRIBUTOR, OR BY CALLING YOUR GLOBAL DOW CORNING CONNECTION.

HEALTH AND ENVIRONMENTAL INFORMATION

To support customers in their product safety needs, Dow Corning has an extensive Product Stewardship organization and a team of Product Safety and Regulatory Compliance (PS&RC) specialists available in each area.

For further information, please see our website, www.dowcorning.com, or consult your local Dow Corning representative.

LIMITED WARRANTY INFORMATION – PLEASE READ CAREFULLY

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