



TRACE ALUMINUM EXTRACTION FROM SAPPHIRE SENSORS

Introduction

All Entegris products are manufactured with high purity and inert materials of construction to withstand the harshest chemical environments. NT® Pressure Transducers designed for vacuum applications use an inert sapphire sensor for vacuum and positive pressure measurement. The sapphire sensor is a form of ultrapure single crystal Al_2O_3 .

Since the sapphire is Al_2O_3 , the sensor material was tested to determine the level of Aluminum and other trace metals extracted using 49% hydrofluoric acid (HF) as the solvent. HF was chosen as the solvent because it is the most powerful etchant used by the semiconductor industry.

Test Procedure

Testing was conducted using both sapphire sensor material samples (coupons), as well as fully assembled pressure transducers. The samples were in contact with 49% HF for a total of 168 hours.

Each sample was cleaned with isopropyl alcohol (IPA), 49% HF, and deionized (DI) water prior to the test. The sapphire coupons were placed in contact with independent volumes of 49% HF. An additional independent sample of 49% HF not in contact with the sapphire material and was used as a control.

After 24 hours, 10 g of liquid HF were removed for sample preparation of trace metals analysis. Ca, K and Fe were analyzed by GFAAS or cold plasma ICP-MS, and all other elements were analyzed by hot plasma ICP-MS.

The same procedure was repeated after 48 and 168 hours for both the sapphire sensor coupons, as well as the fully assembled pressure transducers.

Results

Aluminum was the only leachable trace metal detected in measurable quantity from the sensors. The amounts of all other metals were negligible.

Both the sapphire coupons and complete pressure transducer 49% HF extraction testing yielded similar results: 8 nanograms of Aluminum extracted per sensor per day.

Comparison to SEMI Standard

The SEMI Organization has a published standard for trace metals in high purity liquids, F57-0301 "Provisional specification for polymer components used in ultrapure water and liquid chemical distribution systems." This standard states that polymer products, such as PFA tubing, in contact with semiconductor liquids should extract less than 10 micrograms of Aluminum per square meter of material per 7 days.

The sapphire pressure transducer extracts 8 ng Aluminum/sensor/day. This is the same allowable amount of Aluminum extraction allowed by the SEMI standard for a 2.7" length of 1" I.D. PFA tubing.

Application Example

The extraction rate is 8 ng of Aluminum per day per sensor in contact with 49% HF. If an application flows 100 ml/min. continuously, the calculated Aluminum concentration contributed to the fluid from the sensor will be 0.000068 ppb.

Entegris Products

Experienced in sensors, electronics and process instrumentation, Entegris utilizes proven measurement techniques, cleanroom product assembly and Class 100 work surfaces for all measurement products. Also, for protection against corrosive fumes, the internal electronics are fully encapsulated.

Entegris designs and manufactures measurement instruments for the high purity and corrosive chemical environments of the semiconductor industry. Our products measure flow, pressure and level for the various acids, caustics, solvents, and slurries used in the industry.

For More Information

For more information on Entegris instruments that provide diagnostics, alarms, quick response time, 1% accuracy and no calibration, contact your local Entegris distributor or Entegris, Inc.

For more information concerning this report or to review our complete line of sensing and control product solutions visit Entegris' Web site at www.entegrisfluidhandling.com or contact Entegris Customer Service.

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