

● Chemical Analysis of Metallic Impurities on Fused Silica

Material

TNE0005

Overview

Fused silica is widely used in the cleaning, oxidation/diffusion and CVD steps of the semiconductor manufacturing process. However, along with greater levels of integration in semiconductor devices has come the demand for higher purity fused silica. SCAS has established highly sensitive methods of analysis of any region (top layer, several surface μm and the bulk) for metallic impurities in fused silica materials.

Method

1. Pretreatment

We use our own reagent pretreatments according to objective to enable high sensitivity analysis.

2. Measuring instruments

2.1 Inductively coupled plasma atomic emission spectroscopy (ICP-AES)

2.2 Inductively coupled plasma mass spectroscopy (ICP-MS): Double-focusing ICP-MS, quadrupole ICP-MS

* SCAS conducts all analytical operations from pretreatment to measurement in highly clean rooms to prevent contamination. We pay the utmost attention to contamination prevention strategies across all instruments, reagents, environments and operations.

3. Calculation of results of analysis – Example

3.1 Level of metallic impurities to quantity of etched SiO_2 (ng/g)

3.2 Absolute quantity of metallic impurities (ng)

3.3 Quantity of metallic impurities per unit area of surface area of surface analyzed (ng/cm^2)

4. Lower limits of quantification – Example

The table below shows an example of the lower limits for quantification in the analysis of metallic impurities in the surface 0 – 3 μm layer of a fused silica material.

Table I. 5 mm circumferential cut from single side of 300 mm fused silica wafer (Surface area: 660 cm^2)

| Element | Number of atoms per unit surface area ($\times 10^{10}$ atoms/ cm^2) | Absolute quantity (ng/sample) | Level of metallic impurities (wtppb) |
|---------|---|-------------------------------|--------------------------------------|
| Al | 0.14 | 0.04 | 0.1 |
| Ca | 0.091 | 0.04 | 0.1 |
| Ce | 0.026 | 0.04 | 0.1 |
| Fe | 0.065 | 0.04 | 0.1 |
| K | 0.093 | 0.04 | 0.1 |
| Na | 0.16 | 0.04 | 0.1 |
| Ti | 0.076 | 0.04 | 0.1 |
| Zn | 0.056 | 0.04 | 0.1 |

Table II. Full surface immersion fused silica (52 mm x 52 mm x t3.9 mm) (Contact surface area: 62.2 cm^2)

| Element | Number of atoms per unit surface area ($\times 10^{10}$ atoms/ cm^2) | Absolute quantity (ng/sample) | Level of metallic impurities (wtppb) |
|---------|---|-------------------------------|--------------------------------------|
| Al | 1.4 | 0.04 | 1.0 |
| Ca | 0.97 | 0.04 | 1.0 |
| Cr | 0.74 | 0.04 | 1.0 |
| Cu | 0.61 | 0.04 | 1.0 |
| Fe | 0.69 | 0.04 | 1.0 |
| K | 0.99 | 0.04 | 1.0 |
| Mg | 1.6 | 0.04 | 1.0 |
| Na | 1.7 | 0.04 | 1.0 |

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