Chemical Analysis of Metallic Impurities on Fused Silica Material

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 for analysis of metallic impurities of arbitrary regions (top layer, several surface μm and the bulk) in fused silica materials.

Method

1. Pretreatment

Our original objective pretreatment skills are conducted to enable the highly sensitive 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 Concentration of metallic impurities expressed per amount of etched SiO_2 (ng/g)

3.2 Absolute quantity of metallic impurities (ng)

3.3 Number of atoms of metallic impurities per unit area of the analyzed surface (atoms/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 0 – 3 μm surface layer of a fused silica material.

Table 1 Condition: single side of a 300 mm fused silica wafer with 5 mm circumferential cut (Surface area: 660 cm^2)

Element	Number of atoms per unit surface area ($x10^{10}$ atoms/cm^2)	Absolute quantity (ng/sample)	Concentration 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 2 Full surface of fused silica (52 mm x 52 mm x t3.9 mm) by immersion (Contact surface area: 62.2 cm2)

Element	Number of atoms per unit surface area ($x10^{10}$ atoms/cm^2)	Absolute quantity (ng/sample)	Concentration 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

*Total solution partner for **analyses**, **measurements**, and **evaluations**.*
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