National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Materials

610, Trace Elements in a Glass Matrix (3 mm Wafer)
611, Trace Elements in a Glass Matrix (1 mm Wafer)

(Nominal Trace Element Concentration 500 mg/kg (ppm))

These Standard Reference Materials (SRMs) were produced and certified to facilitate the development of chemical methods of analysis for trace elements and are one of a series of four pairs of SRMs. For both SRMs, 610 and 611, the nominal trace element concentration is 500 mg/kg for each of the sixty-one elements that have been added to the glass support matrix. The two SRMs differ only in the thickness of the glass wafer. Units of SRMs 610 and 611 are issued as sets of six wafers.

(Certified Values are Listed on Page 2)

These materials were prepared in rod form and have been sliced into wafers. The rods were hand-pulled, and therefore are not uniform over their length. Each wafer is oval to circular in cross-section, with a nominal diameter of 12-14 mm. The certified values are for an entire wafer (no fragment thereof). The debris from wafering has been only partially removed and each wafer should be surface cleaned before use. The first step in preparing the wafer for analysis is to wipe it clean with alcohol, and then to give it a mild surface cleaning (not etch) in dilute (1:10) nitric acid. The wafers were cut with a copper-bonded diamond wheel and the nitric acid step is included to remove any possible copper contamination.

Considerable care and effort have gone into the manufacturing of these SRMs to ensure homogeneity. The target level of precision and accuracy for certification of these materials was 2 percent or better. To date no element has been proven to be heterogeneous outside this limit for the SRM wafer used in its entirety. However, spatial inhomogeneity does exist within each wafer. For certification, two or more methods or laboratories must agree to at least the target level.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of W.R. Shields.

The technical and support aspects involved in the original preparation, certification, and issuance of these Standard Reference Materials were coordinated through the Standard Reference Materials Program by J.L. Hague. Revision of this certificate was coordinated through the Standard Reference Materials Program by J.S. Kane.

This Certificate of Analysis has undergone editorial revision to reflect program and organizational changes at NIST and at the Department of Commerce. No attempt was made to reevaluate the certificate values or any technical data presented in this certificate.

Gaithersburg, MD 20899
January 27, 1992
(Revision of certificate dated 1-4-82)

William P. Reed, Chief
Standard Reference Materials Program

(over)

A listing of the 61 elements added and the present status of the analytical certification are given in the following table. An asterisk before the element indicates a certified concentration for that element. The indicated limits on the concentration are equal to the entire range of observed results among sample points and/or the 95 percent confidence interval, whichever is larger. Values in parentheses are information values and are not certified, for the reasons given in the footnotes. Nominal composition of the support matrix is 72% SiO_2, 12% CaO, 14% Na_2O, and 2% Al_2O_3.

Element	Value	Notes	Element	Value	Notes
Antimony	--		Boron	(351)	1,a
Arsenic	--		Cadmium	--	
Barium	--		Cerium	--	
Beryllium	--		Cesium	--	
Bismuth	--		Chlorine	--	
Chromium	--		Europium	--	
Cobalt	(390)	2,b,c	Fluorine	--	
Copper	(444±4)	3,a	Gadolinium	--	
Dysprosium	--		Gallium	--	
Erbium	--		Germanium	--	
Gold	(25)	4,b,d	Lanthanum	--	
Hafnium	--		*Lead	426±1	6,a,f
Holmium	--		Lithium	--	
Indium	--		Lutetium	--	
*Iron	458±9	5,d,e	Magnesium	--	
*Manganese	485±10	7,d,g	Phosphorus	--	
Molybdenum	--		Potassium	(461)	1,a
Neodymium	--		Praseodymium	--	
*Nickel	458.7±4	8,a,d,e	Rhenium	--	
Niobium	--		*Rubidium	425.7±0.8	9,a,h,j
Samarium	--		Sulfur	--	
Scandium	--		Tantalum	--	
Selenium	--		Tellurium	--	
Silver	(254±10)	10,a,b	Terbium	--	
*Strontium	515.5±0.5	11,a,h,j	Thallium	(61.8±2.5)	12,a
*Thorium	457.2±1.2	13,a,f	*Uranium	461.5±1.1	15,a,f
Thulium	--		Vanadium	--	
Tin	--		Ytterbium	--	
Titanium	(437)	14,e	Yttrium	--	
Tungsten	--		Zinc	(433)	16,k
			Zirconium	--	

(All values given in table are in mg/kg (ppm) by weight.)

NOTES:

1. Isotope dilution: interim value because of high blank.
2. Two independent sets of analyses by neutron activation disagree.
3. Isotope dilution: limits dictated by an observed trend in element concentration, well outside the precision of the method.
4. Spectrophotometry and neutron activation give grossly different results, value included only to indicate that the gold was not all lost in the processing of the glass rods.
5. Pooled value from data by spectrophotometry and polarography.
6. Pooled value from data by isotope dilution at two independent laboratories: NIST and USGS.
7. Value by spectrophotometry, substantiated by neutron activation.
8. Isotope dilution data accepted for certification, substantiated by spectrophotometry and polarography.
9. NIST isotope dilution data accepted for certification, cooperating analysts' data have a much larger uncertainty statement (range).
10. Isotope dilution: interim results because of questionable result on Rod No. 78 (8 mg/kg above average, not included in average). Neutron activation data has much larger range.
11. Pooled data: NIST isotope dilution data accepted and substantiated by USGS and Australian National University. The normalized $^{87}Sr/^{86}Sr$ ratio $=0.7094 \pm 0.0002$.
12. Isotope dilution: one method only, large uncertainty statement (range) is the result of a high value for Rod No. 2 which gave results 1.5 mg/kg higher than the average and was not included in the reported average.
13. Pooled isotope dilution data: NIST data accepted for certification and substantiated by USGS.
14. Polarographic: one method only.
15. Isotope dilution: NIST substantiated by USGS. Uranium in glass depleted in ^{235}U. The atom percent $^{235}U=0.2376$.
16. Atomic absorption only: systematic error unknown.

a. All isotope dilution analysis at NIST by staff, Analytical Mass Spectrometry Group
b. Neutron activation - B.A. Thompson
c. Neutron activation - L.W. Masters
d. Spectrophotometry - R.W. Burke
e. Polarography - E.J. Maienthal
f. Isotope dilution - M. Tatsumoto, Isotope Geology Branch, USGS, Federal Center, Denver
g. Neutron activation - T.E. Gills
h. Isotope dilution - C. Hedge, Isotope Geology Branch, USGS, Federal Center, Denver
j. Isotope dilution - W. Compston, Australian National University, Canberra
k. Atomic absorption - T.C. Rains