EFFECT OF RHODIUM NITRATE ON THE ATOMIZATION OF GALLIUM, INDIUM, TELLURIUM AND THALLIUM IN GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY

YOSHINDO FUNATO and MASAHIRO TAKASAKA

Analytical Applications Department, Shimadzu Corporation,
Tokyo, Japan

Abstract - In graphite furnace atomic absorption spectrometry (GFAAS) matrix modifiers have been used for enhancing sensitivity and eliminating interference. In our study, rhodium nitrate was used as matrix modifier for analysis of Ga, In, Te and Tl by GFAAS. The reaction mechanism of rhodium nitrate was elucidated by analysis with X-ray diffractometer and differential thermal analyzer.

Key words matrix modifier gallium, indium, tellurium, thallium

Generally, GFAAS has been used for trace element analysis. However, the sensitivity of some elements is reduced by influence of matrix or characteristic of graphite tube. Especially, in measurement of volatile elements, it causes a serious problem of vaporization to there element during heating stages. In order to produce a higher sensitivity and to eliminate any interference, the matrix modification has been widely used for GFAAS. [1-4] For the determination of Ga, In, Te and Tl in Ni base alloy, addition of rhodium nitrate aqueous solution has been used to increase the sensitivity and to eliminate any interference. In the present study rhodium nitrate aqueous solution was tested as matrix modifier

APPARATUS

A Shimadzu AA-680 atomic absorption spectrometer equipped with a Shimadzu GFA-4B graphite furnace atomizer was used for the measurements. A Shimadzu DT50 differential thermal analyzer and a Shimadzu XD610 X-ray diffractometer were used for the structure analysis.

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1000ppm standard solutions of Ga, In, Te, Tl and rhodium nitrate were purchased from WAKO Pure Chemical Industries.

RESULTS AND DISCUSSION

In GFAAS, selection of appropriate ashing temperature is particularly important when a volatile analyte occurs in a matrix. Fig.1 shows that with the addition of 0.05% rhodium nitrate aqueous solution, the In and Te sensitivity is stable until 1000°C which is similar to that of the below curve. (In, Te only) Fig.1 also shows that rhodium nitrate aqueous solution enhances the sensitivity 8 times and 3 times respectively compared to the signal obtained with In and Te only.

Also the sensitivity of Ga, Tl were enhanced by a factor of 7 and 3, respectively. Each optimum concentration of rhodium nitrate is 0.05% and 0.1%.

In order to get direct experimental evidence to support the enhancement effect, thermal analyzer and X-ray diffractometer studies were carried out.

Fig.2 shows the thermal analysis data for Tl with the addition of rhodium nitrate aqueous solution. This result agree with the general data that rhodium oxide is formed at 600~1000°C and it is decomposed at 1127°C. This general data was also in agreement with the relationship between ashing temperature and rhodium sensitivity in Fig.3.

Fig.4 demonstrates the X-ray diffraction patterns of Tl compound. Some characteristic patterns were observed at room temperature. Specific pattern at 200°C indicates the some compound was formed.

Fig 1 Effect of various ashing temperature

From these results, we came to conclusion that rhodium nitrate aqueous solution stabilizes target element thermally and chemically owing to the formation of stable compounds. Application of this method was made to measure these elements in Ni base alloy. (BCS/SS-CRM NO. 345, 346) Table 1 shows results of measurement of Ga, In and Te in Ni base alloy. We obtained good agreement with certified value. The detection limit of the present method is 1ng for Ge and Tl, 1.8ng for In, and 2.2ng for Te.

Table 1. Results of quantitative determination of Ga, In and Te in Ni base alloy

Element	Sample No. BCS/SS-CRM	Found certified ($\mu\text{g}/\text{ml}$)
Ga	345	8.9
In	346	13.8
Te	346	11.5

Fig. 2 Relationship between ashing temperature and Rh sensitivity

Fig 3 Thermal analysis data for Tl in the presence of Rh

Fig 4 X-ray diffraction pattern of Tl compound

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