Notes

Separation of Thallium and Gold on Activated Carbon

Hideko KOSHIMA[†] and Hiroshi ONISHI^{††}

University of Tsukuba, Tsukuba, Ibaraki 305, Japan

Keywords Separation, thallium, gold, activated carbon

The chloro complexes of thallium(III) and gold(III) behave very similarly and cannot be readily separated from each other.¹ Previously, the authors described a chromatographic method for the separation of thallium(III) and gold(III) on a Sephadex column;¹ the determination was made spectrophotometrically.

Adsorption of thallium(III) and gold(III) on activated carbon from dilute hydrochloric acid solution was studied previously.^{2,3} The authors have found that thallium can be selectively desorbed from activated carbon with dilute nitric acid, while gold remains in activated carbon. This gives a useful alternative method for the separation of thallium(III) and gold(III); any determination method may be employed.

Experimental

Reagents

A standard thallium(III) solution was prepared by dissolving TlNO_3 in 0.05 M sulfuric acid, adding bromine water to the thallium(I) solution in dilute hydrochloric acid, and removing any excess bromine by heating. A standard gold(III) solution was prepared by dissolving the metal in aqua regia, evaporating to near dryness, and dissolving in 1 M hydrochloric acid.

Activated carbon powder (Merck, No. 2186) was used.

Procedure

Twenty milliliters of 1 M hydrochloric acid solution containing 20–200 μg of Tl(III) and 20–2000 μg of Au(III) was stirred mechanically with 100 mg of activated carbon overnight. The carbon was filtered off on a No. 6 filter paper of 110-mm² area with suction and washed with a small volume of 0.1 M hydrochloric acid. Ten milliliters of 1 M nitric acid was passed through the carbon at a flow rate of 1 ml/min. The percolate was analyzed for thallium by flame atomic absorption

spectrometry. The carbon was heated in a porcelain crucible at 600°C for 1 h, then the ash was dissolved in aqua regia. The solution was analyzed for gold by flame atomic absorption spectrometry.

Results and Discussion

Gold(III) was completely adsorbed on activated carbon from 1 M hydrochloric acid solution in 2 h, but thallium(III) took a longer time (overnight) for satisfactory adsorption.

Thallium could be separated from gold by desorption of the former with 0.1–2 M HNO_3 , 0.1–2 M HClO_4 , or 0.1–1 M H_2SO_4 . Desorption of thallium with distilled water was incomplete. Nitric acid (1 M) was adopted.

Table 1 shows results of separation of thallium and gold. The same results were obtained with a different lot of activated carbon. Table 2 shows results of separa-

Table 1 Separation of thallium and gold

Taken/ μg		Found ^a , %	
Tl	Au	Tl	Au
20	200	96.9 $\pm$ 0.7	98.3 $\pm$ 0.8
200	20	96.9 $\pm$ 0.6	98.2 $\pm$ 0.7
200	200	97.5 $\pm$ 0.8	98.2 $\pm$ 0.7

a. Average recovery and relative standard deviation, $n=6$.

Table 2 Separation of iron, thallium, and gold

Taken		Found ^a , %	
Fe 200 μg	}	Fe not adsorbed	96.2
Tl 200 μg		In percolate	
Au 200 μg		Fe	2.0
		Tl	97.2
		In carbon	
		Fe	1.0
		Au	98.7

a. Average of two experiments.

[†] Present address: Department of Materials Chemistry, Faculty of Science and Technology, Ryukoku University, Seta, Otsu 520-21, Japan.

To whom correspondence should be addressed.

^{††} Present address: Kasuga 3-chome 15-5, Tsukuba, Ibaraki 305, Japan.

tion of iron(III), thallium(III), and gold(III).

Previous work⁴ has shown that iron(III), gallium(III), and thallium(III)+gold(III) can be separated from one another on a poly(dibenzo-18-crown-6) column. By incorporation of the present result, thallium and gold can be separated further.

References

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(Received August 10, 1992)

(Accepted November 25, 1992)