BUCK Scientific

Application Note
#AA3003

Determination of Major Components and Trace Contaminants in Assorted Plating Baths by Atomic Absorption Analysis

Precious metal, non-ferrous, and ferrous plating operations cover almost every facet of modern life: automotive parts, kitchen & bathroom fixtures, electrical parts, electronic components, furniture, tools, plumbing, construction supplies, die castings, jewelry, etc.

Good manufacturing practices, and lately, government regulations for environmental safety, have prompted many plating operations to perform more stringent tests on their products. This determines the composition of the major elements in the bath, and also verifies the "cleanliness" of the bath (i.e. no toxic or hazardous metals). Checking the effluent and wastewater from a production operation is also required under most state guidelines. In the past, simple titrimetric or colorimetric tests were sufficient for the determination of major components, but lacked the speed for good quality control methodology, and sensitivity for trace analysis.

Atomic Absorption Spectrophotometry has been an accurate and precise analytical tool for many laboratory environments for over 50 years. The general purpose system lacks the spectral interferences of emission spectroscopy techniques and is significantly more sensitive and accurate than methods such as X-ray fluorescence. The Buck 210VGP AA system is substantially less expensive than almost any other analytical tool, while keeping its unique flexibility and versatility.

Lab Requirements:
5.0ml & 10.0ml Class-A Pipets, 100ml & 500ml Class-A volumetric flasks, distilled water, 110V AC, and air & acetylene tanks.

Procedure:
(1) Pipet 5.0ml of bath into a 100ml flask and dilute with water. Dilution = **1:20** / Use to determine trace elements (~200 ppb)
(2) Pipet 10.0ml of **1:20** into a 100ml flask and dilute with water. Dilution = **1:200** / Use to analyze minor elements (0.1% - 0.0005%)
(3) Pipet 10.0ml of **1:200** into a 500ml flask and dilute with water. Dilution = **1:10,000** / Use to analyze major elements (10% - 0.1%)

Calibration:
A 1.0 ppm standard and matrix blank for trace elements. A 10 to 50 ppm standard and a water blank for major / minor elements.

Analysis:
Insert element lamp, peak in wavelength, optimize energy, set blank zero, calibrate on standard, aspirate sample and read concentration.

The Buck 210VGP Series can accurately determine most elements from 100 ppb to over 10%, depending on the dilution, with typical precision levels of 1.5% or better if using bracketed standards. The entire procedure can be standardized to a simple, easily followed format for a lab technician.

Analytical Results for Various Plating Baths

Samples:	Three (3) baths from an electronics application, a die-cast factory and a chrome-finishing fixtures plant.
Preparation:	Three serial dilutions, as previously described.
Calibration:	Buck Certified Atomic Absorption Standards.
Instrument:	The Buck 210VGP Atomic Absorption Spectrophotometer.
Conditions:	Air / Acetylene flame, Integrate mode, Normal parameters.

NOTE – All values listed below are in Volume Percent (%v) in the original bath sample unless otherwise noted.

AVG = Average of 3 preps, RSD = Relative Standard Deviation of 3 analyses.

Element	Silver-Palladium-Copper in HBF_4		Electroless Nickel / Tin		Hot Dichromate in H_2SO_4	
	AVG	**RSD**	**AVG**	**RSD**	**AVG**	**RSD**
(Majors & Minors in %v)						
Ag	1.37%	0.9%	0.09%	2.3%	<0.01%	-
Pd	0.77%	1.3%	<0.01%	-	<0.01%	-
Cu	2.75%	1.1%	0.73%	0.7%	0.20%	0.5%
Ni	0.23%	1.6%	5.51%	0.9%	1.08%	1.4%
Sn	0.10%	2.4%	2.74%	1.6%	0.63%	2.2%
Cr	<0.01%	-	0.26%	1.8%	7.59%	0.8%
Fe	0.02%	2.9%	0.42%	1.5%	1.16%	1.1%
Au	0.18%	3.2%	~0.01%	4.1%	<0.01%	-
Zn	0.34%	1.7%	0.69%	1.3%	1.03%	0.9%
(Traces in PPM, mg/L)						
Cd	79 ppm	2.8%	130 ppm	1.9%	27 ppm	5.3%
Pb	228 ppm	1.7%	472 ppm	0.7%	115 ppm	2.2%
Mn	24 ppm	3.9%	326 ppm	2.1%	471 ppm	1.8%
Co	<5 ppm	-	554 ppm	1.5%	83 ppm	2.3%

The above data shows the powerful flexibility and stability of the Buck 210VGP system for the wide-ranging requirements of the plating industry. The excellent correlation between major / minor values ranges from 0.7% to 3.2% (average RSD = 1.3%), exemplifying the high precision of the instrument. The overall accuracy of the various trace metals supports the interference-free quality of the data. Together, the combinations provide for an unmatched pair in economy and performance.