

Nickel and cobalt in drinking water with a glassy carbon electrode

Simultaneous low ng/L determination on the modified GC-RDE

Summary

Due to the toxicity and the detrimental effects of nickel and cobalt on human health, their concentrations in drinking water must be controlled. Therefore, EU the legislation specifies 20 µg/L as the limit value for nickel in drinking water. The current provisional guideline value for Ni in the World Health Organization's «Guidelines for Drinking-water Quality» is set to a maximum concentration of 70 µg/L. To monitor the concentrations of Ni and Co with the 884 Professional VA, a method for simultaneous determination on the glassy carbon electrode (GC-RDE) modified with a Bi film is used.

The simplicity of the bismuth film preparation step allows quick and easy regeneration of the sensing layer. The determination is based on adsorptive stripping voltammetry of both elements using dimethylglyoxime (DMG) as a complexing agent. This method results in excellent performance in terms of sensitivity, reaching a limit of detection of 0.05 µg/L for Ni and 0.03 µg/L for Co. This non-toxic method is best suited for both manual and automated systems, allowing the determination in sample series with low to medium number of samples.

Configuration



2.884.0210 - 884 Professional VA manual for CVS

884 Professional VA manual for CVS applications is the entry-level for high-end determinations of organic additives in electroplating baths with "Cyclic Voltammetric Stripping" (CVS), "Cyclic Pulse Voltammetric Stripping" (CPVS), and chronopotentiometry (CP), or voltammetric heavy metal determinations with rotating disk electrodes. The proven Metrohm electrode method combined with a completely new design of potentiostat/galvanostat and the extremely high-performance viva software opens up new perspectives in CVS. The potentiostat with a certified calibrator readjusts itself automatically before each measurement, thus guaranteeing maximum precision. The integrated temperature measurement input allows you to monitor the solution temperature during the measurement. The instrument can also be used to perform voltammetric determinations with the Multi-Mode Electrode or the scTRACE Gold. The replaceable measuring head enables rapid changes between various applications with different electrodes. The viva software is required for control, data acquisition, and evaluation. The 884 Professional VA manual for CVS applications is supplied with extensive accessories and a measuring head for rotating disk electrodes. Electrode set and viva license need to be ordered separately.



6.5339.040 - VA electrode equipment with rotating disk electrode (RDE) made of glassy carbon for Professional VA instruments

Complete electrode set for voltammetric determinations, e.g. using mercury film method. Includes drive for rotating disk electrode, glassy carbon electrode tip, reference electrode, glassy carbon auxiliary electrode, measuring vessel, and electrolyte solution.

Sample

Drinking water, mineral water, sea water

Experimental

Prior to the first determination, an ex-situ bismuth film is deposited from a bismuth solution. In the next step, the electrodes are cleaned with ultrapure water and the bismuth solution is removed. The water sample is placed into the measuring vessel. Ammonium buffer together with the complexing agent (DMG) are added, and the simultaneous determination of nickel and cobalt is carried out with the 884 Professional VA using the parameters specified in **Table 1**. The concentration is determined by two additions of a nickel and cobalt standard addition solution.



Figure 1. 884 Professional VA fully automated for VA

Table 1. Parameters

Parameter	Setting
Mode	DP – Differential Pulse
Deposition potential	-0.8 V
Deposition time	30 s
Start potential	-0.85 V
End potential	-1.25 V
Peak potential Ni	-0.97 V
Peak potential Co	-1.12 V

Electrodes

- Working electrode: Glassy carbon (GC-RDE)
- Reference electrode: Ag/AgCl/KCl (3 mol/L)
- Auxiliary electrode: Glassy carbon rod

Results

With a 30 s deposition time, this method is suitable for the determination of both nickel and cobalt in water samples in concentrations from $\beta(\text{Ni}) = 0.2\text{--}8 \mu\text{g/L}$ and $\beta(\text{Co}) = 0.1\text{--}10 \mu\text{g/L}$. Using a 90 s deposition time, the limit of detection can be lowered to approximately $0.05 \mu\text{g/L}$ for nickel and $0.03 \mu\text{g/L}$ for cobalt.

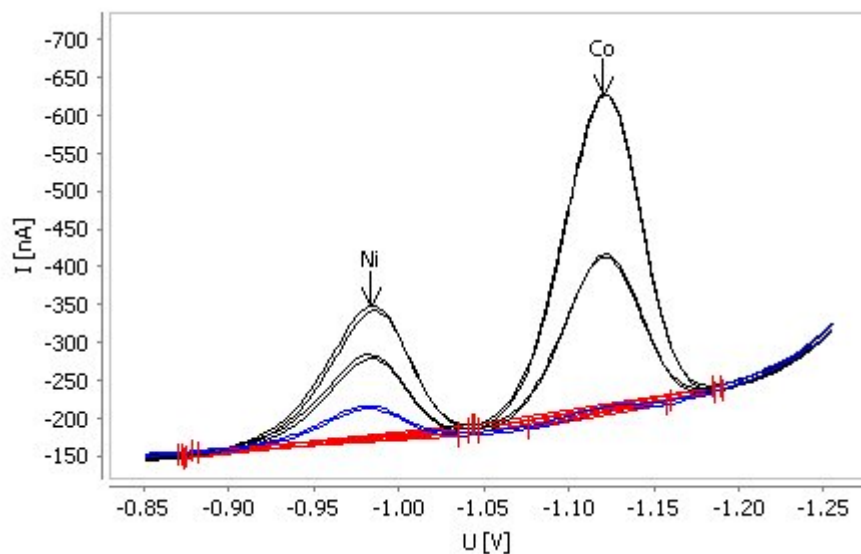


Figure 2. Determination of nickel and cobalt in tap water (30 s deposition time)

Table 2. Result

Sample	Ni ($\mu\text{g/L}$)	Co ($\mu\text{g/L}$)
Tap water	0.34	< LOD

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