

Black Ruthenium 475

Operating Instructions

Edition: 13 June 2007

- Acidic black ruthenium electrolyte
- Decorative black layers up to 0.3 µm coating thickness
- Good colour constancy
- Simple bath maintenance
- Easy to use batch type

Bath Characteristics

Black Ruthenium 475 is a strongly acidic electrolyte from which decorative, anthracite-coloured coatings up to 0.3 µm thickness can be deposited. The bath is easy to operate, the deposits have a high colour constancy and retain their brightness.

Black Ruthenium 475 is used as a final coating for decorative applications, e.g. in the industries producing jewellery, spectacle frames and writing utensils. The wear resistance of the coatings is good.

Pregilding as an undercoat under the black ruthenium layer is strongly recommended (see "Special Process Hints", paragraph "Pretreatment"). If palladium-nickel or palladium are used as undercoats, pregilding is not necessary.

Bath type:	Acidic	
Ruthenium content:	2 g/l	(batch type)
pH-value:	1.0	(0.7 - 1.2) at 25 °C
	1.1	(0.8 - 1.3) at 65 °C
Temperature:	65 °C	(60 - 70 °C)
Current density:	1.5 A/dm ²	(0.5 - 3.0 A/dm ²)
Deposition speed:	Approx. 0.02 µm/min at 2 g/l and 1.5 A/dm ²	
Deposition rate:	Approx. 2 mg/Amin (1 - 3 mg/Amin)	

Coating Characteristics

Coating:	Black ruthenium
Colour:	Anthracite (black)
Density:	Approx. 12 g/cm ³
Max. coating thickness:	0.3 µm

Form of Supply

Bath makeup:	for 1 litre of bath
	Black Ruthenium 475 Initial Concentrate (with Ru), 20 g/l Ru, 100 ml containing 2 g Ru Storage stability: min. 2 years
Bath replenishment:	Not available, batch type
Bath corrections:	For pH corrections, dilute sulphuric acid p.a. and ammonia solution p.a. should be available.

Bath Makeup

Makeup sequence:	To make up 1 litre of bath, stir 100 ml of Black Ruthenium 475 Initial Concentrate slowly into 800 ml of deionized water and fill up to 1 litre with deionized water. Heat the bath up to 65 °C, then measure the pH-value with a glass electrode. If required, adjust the pH to 1.1.
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Operating Conditions

Ruthenium content:	2 g/l	(batch type)
pH-value:	1.0	(0.7 - 1.2) at 25 °C
	1.1	(0.8 - 1.3) at 65 °C
	pH corrections with sulphuric acid p.a. or ammonia solution p.a. (both diluted 1:1).	
	Important: Please note the hints in paragraph "Bath Monitoring and Corrections/pH-value"!	
Operating temperature:	65 °C	(60 - 70 °C)
Bath density:	Approx. 1.014 g/cm ³ (3 °Bé) at makeup	
Product agitation:	Strong agitation required! At least 5 - 10 cm/s! Air agitation is recommended.	

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Bath agitation:	Bath circulation required, min. 2 bath volumes per hour
Filtration:	Continuous filtration through polypropylene filters recommended. Active carbon cartridges not permitted.
Current density:	1.5 A/dm ² (0.5 - 3.0 A/dm ²)
Deposition rate:	Approx. 2 mg/Amin (1 - 3 mg/Amin)
Deposition speed:	Approx. 0.02 µm/min at 1.5 A/dm ² at standard conditions, proportional to current density
Density of the coating:	Approx. 12 g/cm ³

Calculation of Coating Thickness and Plating Time

The maximum coating thickness should not exceed 0.3 µm.

Coating weight in mg = surface in cm² x 1.2 x coating thickness in µm

Plating time in minutes =
$$\frac{\text{required coating weight in mg}}{10 \times \text{current in amperes}}$$

Bath Monitoring and Correction

pH-value:

The pH-value should be checked every day with a glass electrode and adjusted with sulphuric acid or ammonia solution (both p.a. quality and diluted 1 : 1), if required.

The pH-value should be measured at operating temperature (65 °C). At room temperature (25 °C), the pH is approx. 0.1 unit lower.

Caution: If the pH-value is too high the bath will become instable!

Metallic impurities:

The bath attacks the usual basic materials and is sensitive to metallic contaminants like copper, zinc, lead and other metals. See "Special Process Hints", paragraph "Pretreatment". Common metallic impurities such as copper or zinc can be removed by dummy plating at 0.1 A/dm² with corrugated metal sheets or by means of special precipitation methods. The precipitation should be performed only after analytical control and consultation with the supplier.

Special Process Hints

Pretreatment:	The acidic bath attacks the usual basic materials and is sensitive to metallic contaminants. The parts, particularly materials containing copper, iron and zinc, must be protected by pregilding. If palladium-nickel or palladium are used as undercoats, pregilding is not necessary.
Post-treatment:	Important! After plating, the parts should be rinsed in a recovery rinse and then under running water. Then post-treatment for approx. 20 – 30 seconds in a 60 °C warm dilute sodium hydroxide solution (50 g/l NaOH). This post-dip solution neutralizes any electrolyte rests on the surface of the parts and in pores. The solution can be removed by longer rinsing under running water. The last rinse before drying should be deionized water.
Loading of bath when current is on:	If possible, the parts should be immersed when the current is on.
Recovery rinse:	The recovery rinse solution must be adjusted to a pH-value lower than 2. A higher pH results in precipitates (hydrolysis) which are not soluble in the bath and produce faulty deposits.
Barrel:	Due to the reasons stated above under "Pretreatment", the bath is <u>only limitedly suitable for barrel applications</u> . If the parts have a complicated geometry, a 100 % protection of the parts by pregilding possibly cannot be reached, which during subsequent ruthenium plating will lead to faulty deposits and contamination of the bath. Using the bath for barrel applications should therefore be previously tested. On no account does the usability in one specific case indicate that the electrolyte can be used for other articles as well.

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Equipment

Materials:	All parts coming into contact with the bath must be resistant to strong acids. We recommend using polypropylene natural and titanium. All plastic equipment such as tanks, rack insulations, pumps, hoses, filter cartridges etc. prior to use must be rinsed in dilute acid (e.g. 5 % sulphuric acid) for several hours and afterwards cleaned of the contaminated acid by intensive rinsing with water which should be changed several times.
Bath tanks:	Acid-resistant plastic (polypropylene)
Heating:	Adjustable immersion heater with porcelain or quartz sheath, or Teflon-coating.
Anodes:	Platinized titanium, e. g. PLATINODE [®] coated with 2.5 µm of platinum. For fixing, we recommend titanium screws. Anode surface : parts surface at least 2 : 1
Racks:	With acid-resistant coating, contact points of stainless steel or sufficiently gold-plated.
Exhaust system:	An efficient exhaust system is required.

Note

Our information relating to the storage stability refers to storage in closed original storage containers under the conditions stated on the label.

Precautionary Measures/Safety Hints

For information on safety, please see the corresponding Material Safety Data Sheets!

The valid accident prevention regulations and safety instructions must be observed.

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