NB SEMIPLATE AU 100

Bright Au electroplating process, sulfite based, arsenic grain refiner

INTRODUCTION

NB SEMIPLATE AU 100 is an alkaline, non-cyanide electroplating formulation based on arsenic grain refiner which produces a bright, ductile deposit. In comparison with other gold plating processes, the NB SEMIPLATE AU 100 electrolyte demonstrates exceptional throwing power that results in good coverage of recesses, holes and hollows of parts of complex geometry. Deposits from the NB SEMIPLATE AU 100 process also exhibit the unique ability to build brightness with increasing thickness.
NB SEMIPLATE AU 100 deposits have main applications in MEMS processing.

Product	Brightening agent	Surface / grain
NB SEMIPLATE AU 100 **TL**	thallium	matt to semi-bright / coarse
NB SEMIPLATE AU 100	arsenic	shiny / fine

"NB SEMIPLATE AU 100" is shipped **ready-for-use**, while the "**AU 100** xxx" are compounds and used for mixture and maintenance.

READ ENTIRE TECHNICAL DATA SHEET BEFORE USING THIS PRODUCT.

PHYSICAL PROPERTIES OF THE DEPOSIT

Purity	99.9%
Hardness	130 to 190 $HV_{0,020}$
Contact Resistance	0.3 Milliohms*
Deposit weight for 2.5 microns (100 micro inches)	31.6 mg/in² (4.9 mg/cm²)

*Contact resistance measured by cross-wire method with 200 gram load.

MATERIALS REQUIRED

Article No.	Units	Product Name	Comment
204100-00	1, 5, 10, 20 litres	NB SEMIPLATE AU 100	• ready-for-use solution
204100-10	Unit (3l)	AU 100 B	• make up solution
204100-42	1 liter	Au 100 BRIGHTENER AS	• brightening agent based on arsenic • concentrations of this additive can be varied in working solutions based on specific operating preferences
204100-30	1, 2, 5 kg	Au 100 CONDITIONER	• maintains the specific gravity and conductivity of the solution and complexes the gold
204100-20	1 liter	Au 100 X COMPLEX	• gold complex, contains 100g Au per litre
-		Sodium hydroxide (NaOH, reagent grade, 20% by volume)	• required to raise the pH
-		Sulfuric acid (H_2SO_4, reagent grade, 5% by volume solution)	• required to lower the pH

EQUIPMENT REQUIRED

Tanks (liners)	Polypropylene, CPVC, unfilled PVC, and plexiglass are recommended. Viton is a recommended gasket material. If any questions arise as to material compatibility, consult NB Technologies.
Leaching	Leach all tanks and peripheral equipment thoroughly prior to installation of this process.
Heating	Titanium, stainless steel (type 316)
Filtration	Continuous filtration is required. Fiberglass or cellulose can be used to obtain a clear filtrate after carbon treatment. Use properly leached Dynel, or polypropylene filter cartridges.
Rectifiers	Sufficient to develop more than the greatest direct current required with less than 5% ripple at the amperage used.
Anodes	platinated titanium
Ventilation	exhaust according to local regulations

MAKE-UP PROCEDURE

The solution is delivered ready for use.

BATH PARAMETERS

The following table shows the bath parameters, which should be maintained and checked with regular sample analysis.

	NBT analysis	Units	Max. upper limit	Upper action limit	Optimum	Lower action limit	Lowest limit
Au	X	g/l	14.0	13.0	12.0	11.0	10.0
AU 100 BRIGHTENER AS	X	ml/l	160	150	130	110	100
Density	-	g/cm^3	1.24	1.22	1.2	1.18	1.16
pH	(X)	pH	10.9	10.5	9.35	9.2	9.1
Stress level	-	MPa	50	20	0	-40	-80

GENERAL PLATING CONDITIONS

Parameter		**Optimum**	**Range**
Cathode current density	[mA/cm²]	1,5	1 – 6
Flow depending on tool	[l/h]	-	1200 –
Anode to cathode spacing (depends on tool and wafer size)	[cm]		5 - 15
Temperature	[°C]	30	RT to 50

SPECIFIC PROCEDURES

- Oxygen plasma before plating
- chemical pre-treatment not recommended/needed
- Cleaning of all items with DI before insertion in electrolyte
- Wetting of wafer surface with DI water before insertion into bath (check for wetting)
- 1 minute dwelling in bath before current application

SPECIFIC REQUIREMENTS

- Fixtures and anode should be operated in symmetric conditions to the wafer centre (distance of wafer edge to fixture edge, distance of fixture to tank wall, electrical contacting)
- Anode material platinated titanium
- Fixture and others features of PP, PFTE, POM or compatible-proven materials (degreased, leached)

OPERATION

Consistently optimum deposits from the NB SEMIPLATE AU 100 process are easily achieved through conscientious process control. Continuous filtration, vigorous mechanical (not air) agitation and good temperature control are important as well as careful rinsing techniques and the use of a gold strike.
Brightness of the deposit from the NB SEMIPLATE AU 100 process must be maintained. A dull deposit is indicative of process imbalance and will eventually result in decomposition of the solution. To maintain deposit brightness, the gold concentration must be maintained within the specified range. If brightness has been lost, add Au 100 BRIGHTENER AS. If this addition is ineffective, make an addition of Au 100 CONDITIONER. If satisfactory results are not obtained, other problems exist with the solution such as metallic and/or organic contamination or a specific gravity in excess of 1.261g/l.
NOTE: The concentration of conducting salts cannot be readily determined by measuring the specific gravity of the solution because they transform with bath use and time. Periodically send a sample of the solution to NB Technologies for analysis of conducting salts concentration.

MAINTENANCE

Routinely analyze the plating solution for gold concentration to determine the need for replenishment or to verify the accuracy of a replenishment schedule based upon Ampere-minutes of use. NB Technologies offers bath analysis service and sample kits for shipping.

Gold concentration

Actions on Au concentration according to analysis:

- At lower action limit, at lowest limit at the latest, add correspondent amount of Au to the bath
- At upper action limit reduce adding of Au on Amin-basis
- At maximum upper limit stop adding of Au on Amin-basis

Replenishment of Au according to analysis:

- 10ml AU 100 X COMPLEX per 1g of Au to be added

Replenishment of Au on Amin basis:
Beside analysis result, Au can be replenished on the basis of Amin plated.
In the example of a 15 liters bath, replenish 75ml of Au 100 X COMPLEX (equaling 7.5 g Au) after 60Amin plated.

Au 100 BRIGHTENER AS

Actions on Au 100 BRIGHTENER AS according to analysis:

- At lowest limit add correspondent amount of Au 100 BRIGHTENER AS and increase adding of AU 100 BRIGHTENER AS on Amin-basis
- At lower limit increase adding of AU 100 BRIGHTENER AS on Amin-basis
- At upper action limit reduce adding of AU 100 BRIGHTENER AS on Amin-basis
- At maximum upper limit stop adding of AU 100 BRIGHTENER AS on Amin-basis

Replenishment of AU 100 BRIGHTENER AS on the basis of time and/or Amin
The replenishment need of AU 100 Brightener AS is influenced on the conditions of oxygen entrapping into the electrolyte. This is a value of experience and conditions of individual tooling, condition of flow and Amin plated. When flow is minor or turned off for a longer period, there is no need to replenish. Replenishment of AU 100 BRIGHTENER AS on mere time basis is not recommended in the initial phase. In order to find out the individual amount of replenishment influenced by Amin and time, sample analysis correlation over

several weeks of operation is needed. After gaining the replenishment correlation per week operation, the replenishment can be performed on Amin. The time plan for analysis control can be less tight.

Replenishment of AU 100 BRIGHTENER AS on the basis of optical inspection.
When the surface roughness is not satisfactory, the smoothness can be regained by adding AU 100 BRIGHTENER AS. This method might be needed especially during the correlation finding phase.

Provided prerequisites:
1. The surface condition is not caused by other effects (impurities, particles, etc).
2. The AU 100 BRIGHTENER AS concentration is securely far from the maximum upper limit.

➢ Add 20ml/l AU 100 BRIGHTENER AS, until the surface condition gets rid of unsatisfactory roughness.

Control of density and replenishment of conduction salt
Density may be reduced by drag out and fill up with DI-water. Density is to be measured in g/cm³ using a density meter with adequate measurement sensitivity. At 1.261g/cm³ the solution may be needed to be dumped.

Actions on density measurement results:
Make sure Au concentration is within the specified range.
- At lower action limit, at lowest limit at the latest, add 5g/l AU 100 CONDITIONER incrementally to avoid overshooting 1,261g/cm². Dissolve at elevated temperatures (45-55°C).
- At upper action limit intensify measurement cycles
- At maximum upper limit dilute solution to optimum level, analyze diluted solution and replenish according analysis result

pH control and adjustment
During operation the pH tends to drop. pH **MUST** never drop lower than 8, or the Au complex may fall out. Proper operation is provided in the specified range only. At pH over 10, photo resist stability may be affected depending on the type of material.

Actions on pH measurement results:
Make sure to agitate properly during adjustments:
- At lower action limit, at lowest limit at the latest, raise ph by adding 5 to 20% NaOH (100ml NaOH (5%) is common to raise pH from 9,2 to 9,35 in 45 liter bath)
- At maximum upper limit, lower the pH by adding 5% sulphuric acid. This normally is not needed or occurs at new mixture only.

Do not use higher concentrations of sulphuric acid to avoid localised pH drop down lower than pH 8 during addition, otherwise Au may precipitate.

Stress measurement
Stress can be evaluated by sheet film deposition and measurement of the change of wafer bow.

Usual stress level for 7µm film plated at 1.5mA/cm²:
-40MPa compressive stress level tends to drop in tensile direction over operation time

Actions on stress measurement results:
From mechanical perspective the bath can be operated within in the maximum ranges. Still, reaching the ranges is a sign of poor condition of the bath, which gives motivation to set up a new bath. There are no replenishers to adjust stress specifically.
- At lower and upper action limit, check for improper conditions of bath and tool
- At maximum and minimum action limit, and after excluding abnormal tool conditions, consider to perform carbon filtering or to dump the solution right away and reclaim the Au.

Carbon filtering
In order to remove organic contaminations as per analysis or by suspect, organic cleaning and carbon filtering may be applied. After the procedure, analysis and replenishment of the additives is required. Regular carbon filtering is not recommended. Contact NB Technologies for technical assistance.

Impurities
Introduction of metallic impurities into the solution should be prevented by proper rinsing of the parts to be plated. The NB SEMIPLATE AU 100 process is relative tolerant to low levels of heavy metal contaminants, as it will co-deposit these metals without serious effect upon either the appearance or physical properties of the deposit. Organic impurities may be dragged into the plating solution from a variety of sources and will usually result in a significant decrease in plating efficiency which will eventually lead to bath decomposition.

CUSTOMER SUPPORT

Further customer support on the process with this product is available by contacting NB Technologies GmbH.

BATH ANALYSIS SERVICE

NB Technologies supports the bath analysis and provides special shipping kits including shipping box, sample bottles and labels.

DATA LOGGING

Keep a record of ampere-hours of use to determine replenishment volumes. Examples of process log sheets are available by contacting NB Technologies GmbH.

HANDLING AND SAFETY INSTRUCTIONS

For detailed information consult the material safety data sheets for this product.
Please read material safety data sheets carefully before using this product.

DISCLAIMER

All recommendations and suggestions in this bulletin concerning the use of our products are based upon tests and data believed to be reliable. Since the actual use by others is beyond our control, no guarantee expressed or implied, is made by NB Technologies GmbH, its subsidiaries of distributors, as to the effects of such use or results to be obtained, nor is any information to be construed as a recommendation to infringe any patent.

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