ELECTRO-PLATING OF CERTAIN METALS

This chapter addresses specifically the electro-plating of certain metals, which are often used in microelectronics or micro-mechanics due to their specific properties. For each metal, possible electrolytes and the corresponding electro-chemical processes in the electrolytes and the electrodes are explained.

Gold Plating

Application Areas

Due to their very high corrosion resistance, good electrical conductivity, low contact resistance, as well as the good solderability of the gold, gold coatings find wide use in electronics and electrical engineering. Typical layer thicknesses at a few 100 nm (e.g. for a soldering aid) to a few µm is used as a corrosion protection.

Alkaline Cyanide Deposition of Gold

The electrolyte here is based on the highly toxic potassium dicyanoaurate(I) = $K[Au(CN)_2]$. This solution contains approximately 68% gold and dissociates in aqueous solution in K^+- and $[Au(CN)_2]^-$ ions. The latter migrate to the anode and dissociate there to Au^+- and $(CN)^-$ ions. The gold ions migrate back to the cathode, where they are neutralised and deposited on the cathode.

The anode used is either soluble gold or gold-copper electrodes, or insoluble platinum-plated titanium electrodes.

Neutral Cyanide Deposition of Gold

This electrolyte is also based on potassium dicyanoaurate but does not contain any free cyanide (no free $(CN)^-$ ions). Insoluble platinum-plated titanium electrodes are used as an anode.

Acidic Cyanide Deposition of Gold

Here too, potassium dicyanoaurate is the gold source in the electrolyte, which additionally contains cobalt or nickel, as well as citric acid. As a result, shiny gold layers can be obtained, which are comparatively hard because of their relatively large proportion of organic constituents and have a low ductility.

As anodes, either insoluble platinum-plated titanium or stainless steel is used.

Strongly Acidic Cyanide Deposition of Gold

For this purpose, trivalent potassium tetracyanoaurate(III) = $K[Au(CN)_4]$, which is also stable in strongly acidic solutions, forms the metal supply of the electrolyte. Furthermore, mineral acids such as sulphuric or phosphoric acid are added.

Cyanide-free Deposition of Gold with Gold Sulphites

Instead of the highly toxic cyano compounds, the electrolyte is based on Ammonium disulfitoaurate(I) = $(NH_4)_3[Au(SO_3)_2]$ or sodium disulphitoaurate(I) = $(Na)_3[Au(SO_3)_2]$ (alkali metal sulphite). The $[Au(SO_3)_2]^{3-}$ ions of the solution decompose near the cathode into Au^+ and $(SO_3)^{2-}$ ions, the gold ions are reduced to gold on the cathode and deposited.

In addition to dispensing with the highly toxic cyanidic baths, gold layers deposited from sulphite electrolytes have the advantages of excellent macro-scattering ability (= high deposition rates also at current-degraded points of the electrode) and high ductility.

For this reason, our gold bath NB SEMIPLATE AU 100 is based on a sulphite electrolyte.

Gloss Formation

A high brilliance of the deposited gold requires a smooth surface with fine, defined crystalline structure. For this purpose, it is necessary to promote the formation of nuclei during the growth of the gold, while at the same time suppressing the growth of crystals.

This requirement is met, depending on the electrolyte, by the addition of elements such as arsenic, thallium, selenium and lead as well as ethylenediamine, which control the growth of the crystallites by means of a locally selective passivation or a chemical buffering directly at the location of gold deposition.

Nickel Plating

Nickel Plating with Nickel Sulphate

The main metal supplier is nickel sulphate as hexahydrate with the formula $NiSO_4 \cdot (H_2O)_6$, or as heptahydrate ($NiSO_4 \cdot (H_2O)_7$). Nickel chloride as hexahydrate = $NiCl_2 \cdot (H_2O)_6$ serves to improve the anode solubility as well as conducting salt to increase in the electrical conductivity of the electrolyte. Boric acid (H_3BO_3) serves as a chemical buffer to maintain the pH value.

The nickel sulphate dissociates in aqueous solution into Ni^{2+} + and $(SO_4)^{2-}$ ions. The Ni^{2+} ions are reduced to nickel on the cathode, which is deposited there as a metallic coating. The sulphate ions migrate to the copper anode and form new copper sulphate there, which is dissolved in solution, by consuming the anode.

Deposition of Nickel with Chloride Electrolytes

Pure (i.e. nickel sulphate-free) chloride electrolytes consist of $NiCl_2 \cdot (H_2O)_6$ as a metal supplier and conducting salt in one, and boric acid as a chemical buffer.

Compared to nickel sulphate electrolytes, nickel chloride baths allow for a deposition with lower electrical power because of their higher electrical conductivity. However, nickel chloride baths are more expensive and more corrosive than nickel sulphate baths.

Nickel Deposition with Nickel Sulphamate

The main metal supplier of this electrolyte is nickel sulphamate 4-hydrate with the formula $Ni(SO_3NH_2)_2 \cdot (H_2O)_4$, nickel chloride = $NiCl_2$ to improve anode solubility and boric acid (H_3BO_3) as a chemical buffer for maintaining the pH value.

The nickel sulphamate dissociates in aqueous solution into Ni^{2+} and (SO_3NH_2) ions. The Ni^{2+} ions are reduced to nickel on the cathode, which is deposited there as a metallic coating. The sulphate ions migrate to the nickel anode and form new nickel sulphamate there by consuming the anode.

Nickel sulphamate has a very high solubility in water, so that very metal rich baths with high current densities and deposition rates can be prepared, which nevertheless achieve nickel layers with good mechanical properties. The use of a nickel sulphamate-based electrolyte is particularly recommended when thick and stress-free layers are required at the same time. The deposited nickel layer is very ductile and provides good protection against wear and corrosion.

For this reasons, our nickel bath NB SEMIPLATE AU 100 is based on a nickel sulphamate-based electrolyte.

Prerequisites for Shiny Nickel Films

Which surface properties lead to a bright (nickel) surface is not yet fully understood for nickel, even if a very smooth, fine-crystalline structure plays an important role.
 A fine crystalline surface requires, on the one hand, a high nucleation density, on the other hand, that the growth of these nuclei to larger crystallites is suppressed.

Brightening Agent (primary Brighteners)

Additives such as sulphonamides, sulphonimides and sulphonic acids cause a grain refinement of the growing nickel layer, which has a generally high ductility.

Brighteners and Levellers (secondary Brighteners)

Brighteners and levellers as additives enable shiny layers, although less ductile.

Tin Plating

Deposition of Tin with Tin(II)-sulphate

Here the electrolyte solution consists of a sulphuric acid tin(II)-sulphate. The tin sulphate dissociates in aqueous solution into Sn^{2+} and $(SO_4)^{2-}$ ions. The Sn^{2+} ions are reduced to tin on the cathode, which is deposited there as a metallic coating. The sulphate ions migrate to the tin anode and form new tin sulphate there, which is dissolved in solution, by consuming the anode.

Deposition of Tin with Tin(II)-methane Sulphate

Here the electrolyte consists of methane sulphonic acid (CH_3SO_3H) and its salt, tin(II)-methane sulphonate. This salt dissociates in aqueous solution to Sn^{2+} and $(CH_3SO_3)^-$ ions. The Sn^{2+} ions are reduced to tin on the cathode, which is deposited there as a metallic coating. The methane sulphate ions migrate to the tin anode and form new tin(II)-methane sulphate there, which is dissolved in solution, by consuming the anode. Our tin electrolyte NB SEMIPLATE SN 100 is based on tin(II)-methane sulphonate and methane sulfonic acid.

Copper Plating

Application Areas

In electronics, electro-chemical copper-plating is used, among other things, for the construction of printed circuit boards as well as through-connections.

Alkaline Cyanidic Deposition of Copper

In this case, the metal carrier is copper(I)cyanide (CuCN), which is not soluble in water, but in aqueous solutions of NaCN or KCN, with soluble cyanide complexes being formed via $CuCN + 2\ NaCN \rightarrow Na_2[Cu(CN)_3]$. The deposited copper layers show a very good adhesion strength.

Sulphuric (acidic) Deposition of Copper

As an alternative to the highly toxic copper(I)cyanide, the electrolyte for sulphuric based deposition consists of copper sulphate ($CuSO_4$) dissolved in diluted sulphuric acid. The copper sulphate dissociates in Cu^{2+} and $(SO_4)^{2-}$ ions in aqueous solution. The Cu^{2+} ions are reduced on the cathode to copper, which is deposited there as a metallic coating. The sulphate ions migrate to the copper anode and form new copper sulphate there, which is dissolved in solution, by consuming the anode.

The sulphuric acid not only serves to improve the conductivity of the electrolyte, but is the prerequisite for a coherent, uniform layer deposition.

Our nickel bath NB SEMIPLATE CU 100 is made of copper sulphate dissolved in diluted sulphuric acid.

Electro-plating Deposition of Silver

Application Areas

In (micro)electronics, silver layers are used because of their good electrical properties: Among all metals, silver has the highest electrical conductivity.

Cyanidic Deposition of Silver

Since silver cyanide (AgCN) is almost insoluble in water, potassium cyanide (KCN) is added to the electrolyte, increasing the concentration of free cyanide. Depending on the concentration of free cyanide, the equilibrium concentrations of the soluble cyanide complexes dicyanoarate = $[Ag(CN)_2]^-$, tricyanoarate = $[Ag(CN)_3]^{2-}$ and tetracyanoarate = $[Ag(CN)_4]^{3-}$ adjust.

Cyanide-free Deposition of Silver

As an alternative to the highly toxic silver cyanide, a whole series of less or non-toxic complexing agents, for example iodide, sulphite, ethylenediamine or thiourea.

PHOTORESIST PROCESSING IN THE MICRO-ELECTROPLATING

Photoresist masks for electrochemical plating are usually subject to very specific requirements with regard to chemical resistivity and resist profile. This chapter describes how these requirements can be met by using suited resists and applying optimized resist processing.

Optimally Suitable Photoresists

Acidic and Alkaline Resistivity of the Resist Mask

The phenol and acrylic resins used as the resist matrix of all current AZ® and TI resists make these photoresists predominantly stable in acidic plating solutions as long as they do not contain higher concentrations of strongly oxidising media such as nitric acid.

Alkaline solutions, on the other hand, can attack a non-cross-linked (positive) resist mask from a pH value of about 10 on which deteriorates the solution with organic compounds from the resist, depending on temperature and duration of the solution and plating process. It should be noted that the pH value measured in the bath does not have to agree with that at the location of the metal deposition (and therefore at the location of the resist structures).

A hardbake can increase the alkaline resistance of positive resists only from temperatures of approx. 140°C. These are above the softening point of all the positive resists, as a result of which the resist profiles are roughened after such a hardbake and thus are generally no longer suitable for electroplating.

Cross-linking negative resists like the AZ® nLOF 2000 series, the AZ® 15 nXT or the AZ® 125 nXT have a significantly higher alkaline stability compared to positive resists.

Resist Adhesion to The Substrate

Due to the swelling of photoresist, the adhesion to the substrate during plating can be reduced and metal can infiltrate the resist film undercutting it. The resist adhesion can be optimised via the resist selection, its processing as well as the substrate pretreatment.

The AZ® 1500, 4500, 9200 and ECI 3000 resist series show a fundamentally improved adhesion to the substrate compared to resists optimised for dry-chemical processes. Cross-linking negative resists such as the AZ® nLOF 2000 series or the AZ® 15 nXT or AZ® 125 nXT also have very good adhesion.

Optimisation of the Resist Adhesion

Adhesive Layer

In general, a thin metal film as an adhesion promoter is highly recommended for applications in electroplating, since in many cases a metallic seed layer is required in any case: A few nm thin titanium or chromium film significantly improves the resist adhesion especially compared with gold or platinum. Such a thin metal film may be removed, if necessary, after development on the freely developed sites in the appropriate media. Care must be taken here to ensure that the metal film is not etched too far laterally under the resist, i.e. the etching process does not take much longer than required for the removal of the freely developed metal film.

Softbake and Hardbake

Optimal softbake parameters (for most common resists, we recommend 100°C for one minute per µm of resist film thickness on the hotplate, a few minutes longer in oven processes) also improve the adhesion of the resist. It is especially important for thick resist films to prevent an abrupt cooling of the substrate after the softbake in order to prevent cracking in the photoresist film. A baking step after development can improve the adhesion of the resist, but in the case of positive resists, the temperatures necessary for this - 120-140°C - are mostly above the softening point of the resist used, which allows the resist structures to be softened. In the case of negative resists, such a hardbake can be carried out without the risk of softening the resist profile. However, as the hardbake temperature increases, the later removability of the resist mask in common strippers decreases.

Residual Solvent

Photoresist layers baked under conventional softbake parameters still have a remaining solvent concentration of a few percent. If the solvent contaminates the plating solution, the chemistry of the electrolyte can be disturbed or the plating solution completely deteriorated.

In this case, a more intensive (i.e. longer or hotter) softbake is recommended. In the case of thick resist films, which even after a long softbake show a rel. high remaining solvent content especially close to the substrate, a baking step can be helpful after development. In order to attain the resist sidewalls when using positive resists, this should be carried out no higher than 20°C below the softening temperature of the photoresist used. In the case of cross-linked negative resists, no subsequent softening of the resist structures is to be feared, but the removability of the resist mask after electroplating is decreased when

baking temperatures are too high.

Optimisation of the Adhesion of the Deposited Metal

Development

If the photoresist is developed with an unsuitable developer or is not sufficiently rinsed after the development, a few nm thin, difficult-to-detect resist residuals can prevent an optimal growth of the deposited metal.

If such resist residuals are present despite a sufficiently long development and subsequent rinsing, the use of the TMAH-based developer AZ® 826 MIF (either as a developer for the entire resist film, or applied in an approx. 30 second dip after the actual development) can remedy this through its special additive.

Adhesion Promoter

Incorrectly applied adhesion promoters such as, for example, liquid HMDS can also reduce the adhesion of the grown metal to the seed layer.

Metal organic adhesion promoters such as TI PRIME can also degrade the adhesion of the grown metal if they are not removed in the developed regions by, for example, an HF dip.

Resist Profile

Vertical Sidewalls

If vertical resist sidewalls are desired, the positive resists of the AZ® ECI 3000 are recommended for a few µm thick photoresist masks. The AZ® 4562 or AZ® 9260 or the AZ® 15 nXT negative resists are also suitable for 5 to 30 µm thick films. The positive AZ® 40 XT or the negative resist AZ® 125 nXT allow very large resist film thicknesses of 30 - 150 µm with very steep sidewalls.

Negative Sidewalls

If the deposited metal structure is to have a positive sidewall profile which requires negative sidewalls for the resist mask, the AZ® nLOF 2000 negative resist series is recommended as a resist mask for film thickness up to approx. 20 µm, for even greater film thicknesses, the negative resist AZ® 15 nXT is recommended. For both resists, the shape of the undercut can be adjusted over a wide range via the exposure dose and the post exposure bake.

APPLICATION EXAMPLES

In this last chapter on electroplating, we would like to present some technological "highlights", which were realised with the electrolytes and in part, the photoresists which we sell.

These application examples and the illustrations shown originate from our co-operation partner and manufacturer of the plating solutions NB Technologies (www.nb-technologies.com).

Micro Switches

Fig. 140 shows a CCD microscope photo of a thermal, laterally actuatable, bi-stable micro switch. The mechanically movable elements consist of 12 µm thick electroplated nickel (plating solution used: *NB Semiplate Ni 100*). The smallest dimension of the Ni bars is 4 µm. The contact elements consist of gold (electrolyte: *NB Semiplate Au 100*).
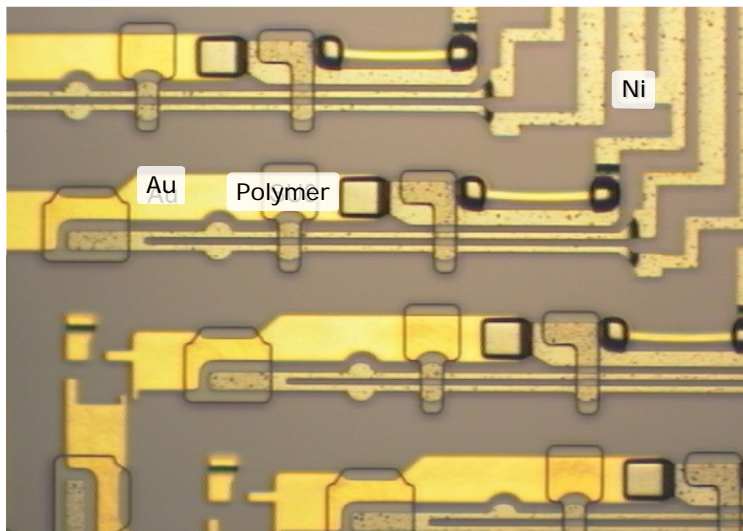
Fig. 140: CCD microscope image of a thermal, laterally actuatable, bi-stable micro switch.
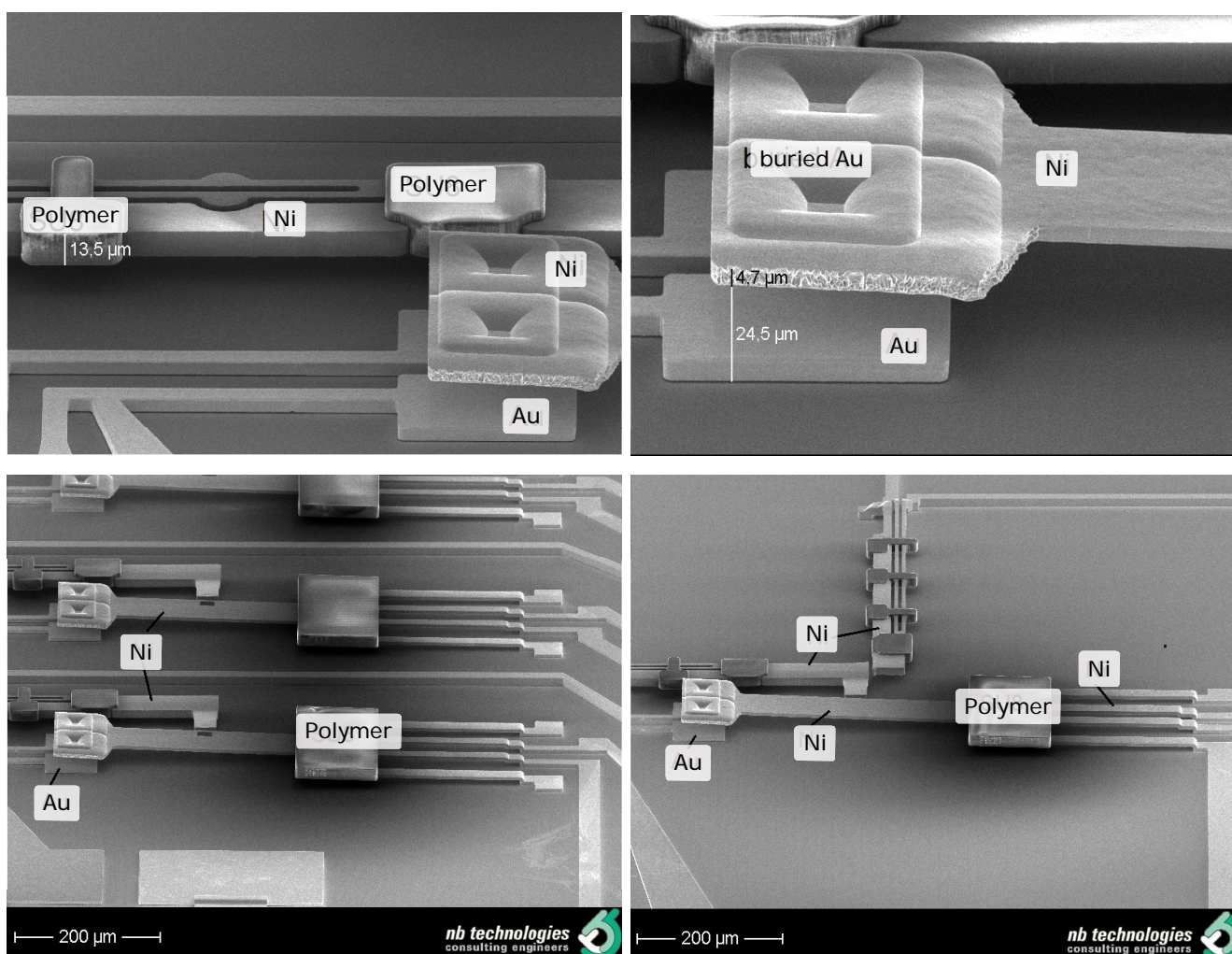
Fig. 141: REM images of a thermal actuator and a contact of a micro switch, manufactured using the gold and copper electrolyte *NB Semiplate Au 100* and *NB Semiplate Cu 100*

The transparent elements consist of a cross-linked negative resist and serves the mechanical connection.

Essential requirements for electroplating are to avoid stress gradients, thickness irregularities, in particular with different structural dimensions, and the long-term stability of the properties under mechanical and thermal stress.

The different planes can be clearly seen by the overgrowth of the nickel as a bond to gold structures as well as the overgrowth of the nickel bars over the edge of the sacrificial film (from approx. 4 µm thick Cu, already removed). These different levels place a high demand on the resist process (here AZ® 9260).

Fig. 141 shows several SEM images of a thermal actuator and a contact of a micro switch.

Mechanical elements consist of bright nickel (electrolyte: *NB Semiplate Ni 100*). For the purpose of achieving the vertical deflection, a stress gradient in the nickel film is set by the deposition parameters.

Again, the stability of the grain structure is of fundamental importance. The contact area is made of bright gold (electrolyte: *NB Semiplate Au 100*). In order to expose the moving elements, sacrificial films of copper (electrolyte: *NB Semiplate Cu 100*) with very good thickness uniformity and surface quality is used.

Elements of cross-linked negative resist are used for electrical separation and mechanical bonding.

Fig. 145 shows a REM image of the actuator structure of the micro switch of nickel (electrolyte: *NB Semiplate Ni 100*).

The narrow nickel bars were deposited on a sacrificial layer made of copper (electrolyte: *NB Semiplate Cu 100*)

Fig. 142: (right) view of a structured nickel deposition (FIB cut)

Fig. 143: (below) REM image of lateral micro-contacts of gold (*NB Semiplate Au 100*) on copper upper film (*NB Semiplate Cu 100*)

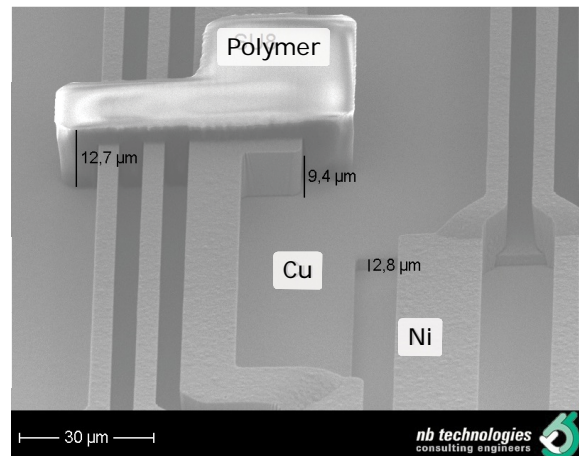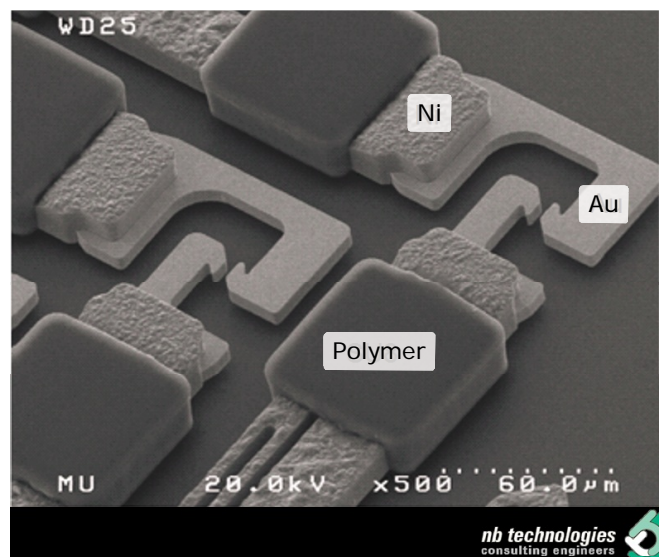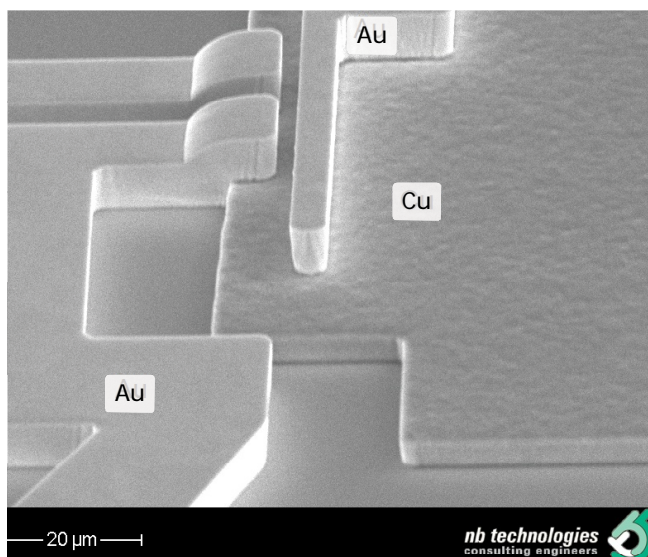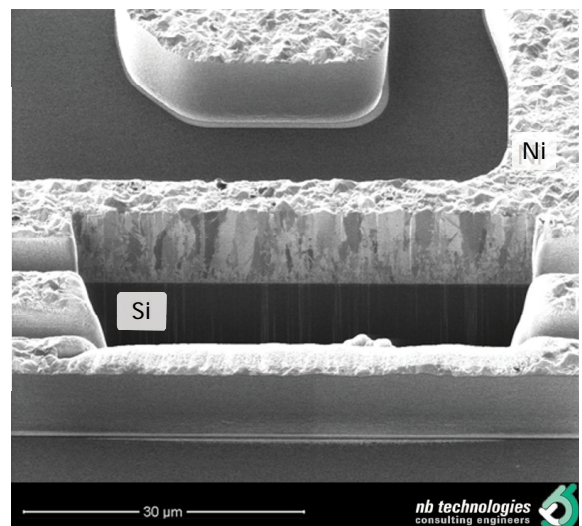Fig. 144: (right below) REM image of the contact area of the micro switch.

Fig. 145: REM photo of the actuator structure of the micro switch of nickel (electrolyte: NB Semiplate Ni 100)

with good thickness uniformity and high surface quality.

The thickness of the sacrificial layer is here about 3 µm. The overgrowth of the nickel structure over the edge of the sacrificial layer is clearly visible. The width of the nickel bars is about 4 µm, the edge steepness is almost 90°. Such conditions and requirements place high demands on the resist process. Here, a resist process with 18 µm of AZ® 9260 was optimised with an aspect ratio of 4.5 with almost vertical sidewalls over a copper edge of about 3 µm. The differently strong reflections of the film underneath (copper sacrificial layer and gold seed layer) require a careful adjustment of the exposure parameters.

Fig. 142 shows the cross section of a structured Ni deposition (FIB section). The nickel was processed without the brightness additive. The grain structure and the typical "stem growth" can be seen. The smaller grain structure is clearly visible in the lower film area, where the adaptation to the substrate takes place.

In some applications, special attention should be given to the film growth properties. Brightness, stress and grain growth can be influenced within certain limits by supplements, but also by process management. An admixture of Mn, for example, protects the grain structure from changes in mechanical or thermal stress. A fine grain structure such as here with 4 µm in width can be preferred for narrow "spring elements", but only if it is ensured that the grains are stable and do not increase or change under mechanical or thermal stress.

Fig. 143 shows the REM image of a lateral micro-contact made of gold (*NB Semiplate Au 100*) on copper sacrificial layer (*NB Semiplate Cu 100*). The copper sacrificial layer shows a very good thickness uniformity and surface quality.

It is remarkable that the slight, but recognisable, higher roughness of the sacrificial layer is levelled out again by the gold deposition.

Fig. 144 shows the REM image of the contact area of the micro switch. The contacts are made of bright gold (*NB Semiplate Au 100*). If necessary, the NB Semiplate Au 100 can be modified with a palladium addition (to *NB Semiplate AuPd 100*) in order to improve the contact properties.

The nickel of the thermal actuator (*NB Semiplate Ni 100*) is bonded to the gold contact by overgrowth. The nickel is processed with low brightness with respect to the adhesion to the polymer. A certain fineness of the grain size with respect to the mechanical properties in the spring element with a small width of only 4 µm (Fig. 142) is, however, processed.

Multilayer Wiring on Thin Films.

Fig. 146: *NB Semiplate Au 100* is used for the metallisation of multilayer wiring in combination with thin films.

Shown here are 12 µm thick polyimide films with two metallisation planes. Particular requirements apply here with regard to adhesive strength, film stress, stability of the properties and levelling of topographies.
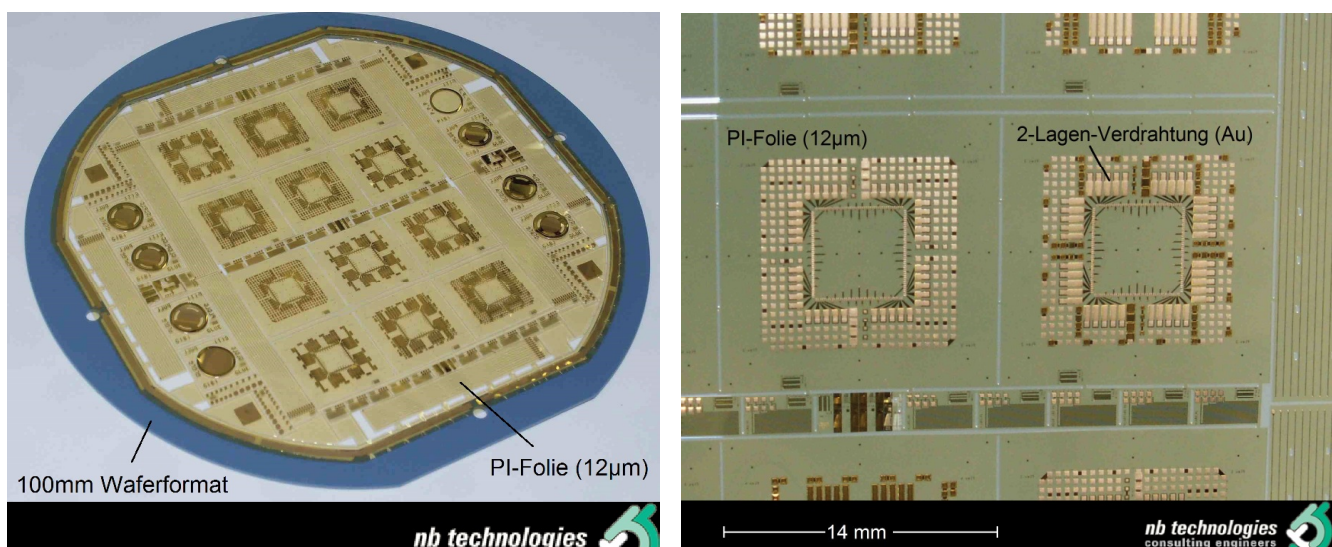

Fig. 146: 12µm thick polyimide foils with two levels of metallisation

Our Photoresists: Application Areas and Compatibilities

	Recommended Applications [1]	Resist Family	Photoresists	Resist Film Thickness [2]	Recommended Developers [3]	Recommended Removers [4]
Positive	Improved adhesion for wet etching, no focus on steep resist sidewalls	AZ® 1500	AZ® 1505 AZ® 1512 HS AZ® 1514 H AZ® 1518	≈ 0.5 µm ≈ 1.0 - 1.5 µm ≈ 1.2 - 2.0 µm ≈ 1.5 - 2.5 µm	AZ® 351B, AZ® 326 MIF, AZ® 726 MIF, AZ® Developer	AZ® 100 Remover, TechniStrip® P1316 TechniStrip® P1331
		AZ® 4500	AZ® 4533 AZ® 4562	≈ 3 - 5 µm ≈ 5 - 10 µm	AZ® 400K, AZ® 326 MIF, AZ® 726 MIF, AZ® 826 MIF	
		AZ® P4000	AZ® P4110 AZ® P4330 AZ® P4620 AZ® P4903	≈ 1 - 2 µm ≈ 3 - 5 µm ≈ 6 - 20 µm ≈ 10 - 30 µm	AZ® 400K, AZ® 326 MIF, AZ® 726 MIF, AZ® 826 MIF	
		AZ® PL 177	AZ® PL 177	≈ 3 - 8 µm	AZ® 351B, AZ® 400K, AZ® 326 MIF, AZ® 726 MIF, AZ® 826 MIF	
	Spray coating	AZ® 4999		≈ 1 - 15 µm	AZ® 400K, AZ® 326 MIF, AZ® 726 MIF, AZ® 826 MIF	
	Dip coating	MC Dip Coating Resist		≈ 2 - 15 µm	AZ® 351B, AZ® 400K, AZ® 326 MIF, AZ® 726 MIF, AZ® 826 MIF	
	Steep resist sidewalls, high resolution and aspect ratio for e. g. dry etching or plating	AZ® ECI 3000	AZ® ECI 3007 AZ® ECI 3012 AZ® ECI 3027	≈ 0.7 µm ≈ 1.0 - 1.5 µm ≈ 2 - 4 µm	AZ® 351B, AZ® 326 MIF, AZ® 726 MIF, AZ® Developer	
		AZ® 9200	AZ® 9245 AZ® 9260	≈ 3 - 6 µm ≈ 5 - 20 µm	AZ® 400K, AZ® 326 MIF, AZ® 726 MIF	
	Elevated thermal softening point and high resolution for e. g. dry etching	AZ® 701 MiR	AZ® 701 MiR (14 cPs) AZ® 701 MiR (29 cPs)	≈ 0.8 µm ≈ 2 - 3 µm	AZ® 351B, AZ® 326 MIF, AZ® 726 MIF, AZ® Developer	
Positive (chem. amplified)	Steep resist sidewalls, high resolution and aspect ratio for e. g. dry etching or plating	AZ® XT	AZ® 12 XT-20PL-05 AZ® 12 XT-20PL-10 AZ® 12 XT-20PL-20 AZ® 40 XT	≈ 3 - 5 µm ≈ 6 - 10 µm ≈ 10 - 30 µm ≈ 15 - 50 µm	AZ® 400K, AZ® 326 MIF, AZ® 726 MIF	AZ® 100 Remover, TechniStrip® P1316 TechniStrip® P1331
		AZ® IPS 6050		≈ 20 - 100 µm		
Image Reversal	Elevated thermal softening point and undercut for lift-off applications	AZ® 5200	AZ® 5209 AZ® 5214	≈ 1 µm ≈ 1 - 2 µm	AZ® 351B, AZ® 326 MIF, AZ® 726 MIF	TechniStrip® Micro D2 TechniStrip® P1316 TechniStrip® P1331
		TI	TI 35ESX TI xLift-X	≈ 3 - 4 µm ≈ 4 - 8 µm		
Negative (Cross-linking)	Negative resist sidewalls in combination with no thermal softening for lift-off application	AZ® nLOF 2000	AZ® nLOF 2020 AZ® nLOF 2035 AZ® nLOF 2070	≈ 1.5 - 3 µm ≈ 3 - 5 µm ≈ 6 - 15 µm	AZ® 326 MIF, AZ® 726 MIF, AZ® 826 MIF	TechniStrip® NI555 TechniStrip® NF52 TechniStrip® MLO 07
		AZ® nLOF 5500	AZ® nLOF 5510	≈ 0.7 - 1.5 µm		
	Improved adhesion, steep resist sidewalls and high aspect ratios for e. g. dry etching or plating	AZ® nXT	AZ® 15 nXT (115 cPs) AZ® 15 nXT (450 cPs)	≈ 2 - 3 µm ≈ 5 - 20 µm	AZ® 326 MIF, AZ® 726 MIF, AZ® 826 MIF	
			AZ® 125 nXT	≈ 20 - 100 µm	AZ® 326 MIF, AZ® 726 MIF, AZ® 826 MIF	TechniStrip® P1316 TechniStrip® P1331 TechniStrip® NF52 TechniStrip® MLO 07

[1] In general, almost all resists can be used for almost any application. However, the special properties of each resist family makes them specially suited for certain fields of application.
[2] Resist film thickness achievable and processable with standard equipment under standard conditions. Some resists can be diluted for lower film thicknesses; with additional effort also thicker resist films can be achieved and processed.
[3] Metal ion free (MIF) developers are significantly more expensive, and reasonable if metal ion free development is required.

Our Developers: Application Areas and Compatibilities

Inorganic Developers
(typical demand under standard conditions approx. 20 L developer per L photoresist)

AZ® Developer is based on sodium phosphate and –metasilicate, is optimized for minimal aluminum attack and is typically used diluted 1 : 1 in DI water for high contrast or undiluted for high development rates. The dark erosion of this developer is slightly higher compared to other developers.

AZ® 351B is based on buffered NaOH and typically used diluted 1 : 4 with water, for thick resists up to 1 : 3 if a lower contrast can be tolerated.

AZ® 400K is based on buffered KOH and typically used diluted 1 : 4 with water, for thick resists up to 1 : 3 if a lower contrast can be tolerated.

AZ® 303 specifically for the AZ® 111 XFS photoresist based on KOH / NaOH is typically diluted 1 : 3 - 1 : 7 with water, depending on whether a high development rate, or a high contrast is required

Metal Ion Free (TMAH-based) Developers
(typical demand under standard conditions approx. 5 - 10 L developer concentrate per L photoresist)

AZ® 326 MIF is 2.38 % TMAH- (TetraMethylAmmoniumHydroxide) in water.

AZ® 726 MIF is 2.38 % TMAH- (TetraMethylAmmoniumHydroxide) in water, with additional surfactants for rapid and uniform wetting of the substrate (e. g. for puddle development)

AZ® 826 MIF is 2.38 % TMAH- (TetraMethylAmmoniumHydroxide) in water, with additional surfactants for rapid and uniform wetting of the substrate (e. g. for puddle development) and other additives for the removal of poorly soluble resist components (residues with specific resist families), however at the expense of a slightly higher dark erosion.

Our Removers: Application Areas and Compatibilities

AZ® 100 Remover is an amine solvent mixture and standard remover for AZ® and TI photoresists. To improve its performance, AZ® 100 remover can be heated to 60 - 80°C. Because the AZ® 100 Remover reacts highly alkaline with water, it is suitable for this with respect to sensitive substrate materials such as Cu, Al or ITO only if contamination with water can be ruled out..

TechniStrip® P1316 is a remover with very strong stripping power for Novolak-based resists (including all AZ® positive resists), epoxy-based coatings, polyimides and dry films. At typical application temperatures around 75°C, TechniStrip® P1316 may dissolve cross-linked resists without residue also, e.g. through dry etching or ion implantation. TechniStrip® P1316 can also be used in spraying processes. For alkaline sensitive materials, TechniStrip® P1331 would be an alternative to the P1316. Nicht kompatibel mit Au oder GaAs.

TechniStrip® P1331 can be an alternative for TechniStrip® P1316 in case of alkaline sensitive materials. TechniStrip® P1331 is not compatible with Au or GaAs.

TechniStrip® NI555 is a stripper with very strong dissolving power for Novolak-based negative resists such as the AZ® 15 nXT and AZ® nLOF 2000 series and very thick positive resists such as the AZ® 40 XT. TechniStrip® NI555 was developed not only to peel cross-linked resists, but also to dissolve them without residues. This prevents contamination of the basin and filter by resist particles and skins, as can occur with standard strippers. TechniStrip® NI555 is not compatible with GaAs.

TechniClean™ CA25 is a semi-aqueous proprietary blend formulated to address post etch residue (PER) removal for all interconnect and technology nodes. Extremely efficient at quickly and selectively removing organo-metal oxides from Al, Cu, Ti, TiN, W and Ni.

TechniStrip™ NF52 is a highly effective remover for negative resists (liquid resists as well as dry films). The intrinsic nature of the additives and solvent make the blend totally compatible with metals used throughout the BEOL interconnects to WLP bumping applications.

TechniStrip™ Micro D2 is a versatile stripper dedicated to address resin lift-off and dissolution on negative and positive tone resist. The organic mixture blend has the particularity to offer high metal and material compatibility allowing to be used on all stacks and particularly on fragile III/V substrates for instance.

TechniStrip™ MLO 07 is a highly efficient positive and negative tone photoresist remover used for IR, III/V, MEMS, Photonic, TSV mask, solder bumping and hard disk stripping applications. Developed to address high dissolution performance and high material compatibility on Cu, Al, Sn/Ag, Alumina and common organic substrates.

Our Wafers and their Specifications

Silicon-, Quartz-, Fused Silica and Glass Wafers

Silicon wafers are either produced via the Czochralski- (CZ-) or Float zone- (FZ-) method. The more expensive FZ wafers are primarily reasonable if very high-ohmic wafers (> 100 Ohm cm) are required.

Quartz wafers are made of monocrystalline SiO_2, main criterion is the crystal orientation (e. g. X-, Y-, Z-, AT- or ST-cut)

Fused silica wafers consist of amorphous SiO_2. The so-called JGS2 wafers have a high transmission in the range of ≈ 280 - 2000 nm wavelength, the more expensive JGS1 wafers at ≈ 220 - 1100 nm.

Our glass wafers, if not otherwise specified, are made of borosilicate glass.

Specifications

Common parameters for all wafers are diameter, thickness and surface (1- or 2-side polished). Fused silica wafers are made either of JGS1 or JGS2 material, for quartz wafers the crystal orientation needs to be defined. For silicon wafers, beside the crystal orientation (<100> or <111>) the doping (n- or p-type) as well as the resistivity (Ohm cm) are selection criteria.

Prime- ,Test-, and Dummy Wafers

Silicon wafers usually come as „Prime-grade" or „Test-grade", latter mainly have a slightly broader particle specification. „Dummy-Wafers" neither fulfill Prime- nor Test-grade for different possible reasons (e. g. very broad or missing specification of one or several parameters, reclaim wafers, no particle specification) but might be a cheap alternative for e. g. resist coating tests or equipment start-up.

Our Silicon-, Quartz-, Fused Silica and Glass Wafers

Our frequently updated wafer stock list can be found here: è www.microchemicals.com/products/wafers/waferlist.html

Further Products from our Portfolio

Plating

Plating solutions for e. g. gold, copper, nickel, tin or palladium: è www.microchemicals.com/products/electroplating.html

Solvents (MOS, VLSI, ULSI)

Acetone, isopropyl alcohol, MEK, DMSO, cyclopentanone, butylacetate, ... è www.microchemicals.com/products/solvents.html

Acids and Bases (MOS, VLSI, ULSI)

Hydrochloric acid, sulphuric acid, nitric acid, KOH, TMAH, … è www.microchemicals.com/products/etchants.html

Etching Mixtures

for e. g. chromium, gold, silicon, copper, titanium, ... è www.microchemicals.com/products/etching_mixtures.html