Wide range of applications
High purity product

Nickel Sulfamate

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"Nickel Sulfamate" is a highly precise and quality surface treatment chemical which utilized the outstanding plating characteristic. We have been accepting trust of the quality for over the years.

Nickel Sulfamate bath is used for wide applications such as functional plating to following.

Electronic components : Connector, Lead frame, Chip resistor etc.

Electroforming products : Metal mask, Resin mold, Stamper, Diamond cutter etc.

Advanced technique to control plating film properties such as precision and hardness, internal stress is required. To meet these needs, we have various products of Nickel Sulfamates and additives.

Features

1. High speed plating is possible more than general Nickel bath (Watts bath).
2. Plating bath composition is simple, so control is easy.
3. Solubility to water is large. Use by high concentration and high current is possible.
4. Influence of impurities is slight.
5. Internal stress is very small, so suitable for various electroformings.
6. Purity of our products is high, surface of the electrodeposit will be fine-grained.
7. Film properties of the electrodeposit are excellent in reproducibility under the same operating conditions.

Type and specification

Concentration as $Ni(NH_2SO_3)_2 \cdot 4H_2O$	Specific gravity at 30°C	pH	Fe	Cu	Zn	Pb	Co
			max.%				
60% Nickel Sulfamate Solution							
> 900 g/L (60wt%)	1.50±0.02	4.7 to 5.1	0.0001	0.0001	0.0005	0.0001	—
60% Nickel Sulfamate Solution (High purity)							
> 900 g/L (60wt%)	1.50±0.01	4.7 to 5.1	0.0001	0.0001	0.0001	0.0001	0.0003
65% Nickel Sulfamate Solution							
> 1,014 g/L (65wt%)	1.56±0.02	4.4 to 5.0	0.0001	0.0001	0.0005	0.0001	—

Purity	pH *1	Fe	Cu	Zn	Pb	Co
		max.%				
Nickel Sulfamate						
> 96%	3.0	0.001	0.001	0.001	0.001	—

*1 : Nickel Sulfamate 30g + Boric acid 3g + water → 100mL

Representative bath composition and operating conditions

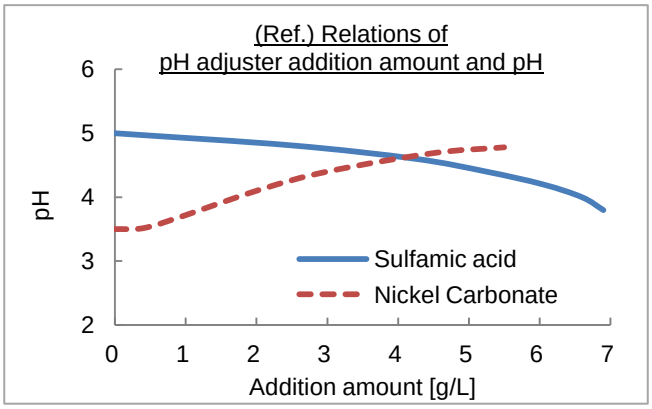
	Normal	High-concentration	High-speed
*2 Nickel Sulfamate	350 to 450 g/L	600 g/L	600 g/L
*2 60% Nickel Sulfamate Solution	600 to 750 g/L	1,000 g/L	1,000 g/L
*3 Nickel Chloride	5 g/L	5 g/L	5 g/L
*3 Nickel Bromide	3 to 10 g/L	—	—
Boric acid	30 to 40 g/L	30 to 40 g/L	40 g/L
*4 Additives	proper quantity	proper quantity	proper quantity
*2 ,*3 : Initial make-up using either		*4 : As necessary	
Bath temperature	40 to 60°C	40 to 60°C	40 to 60°C
Cathode current density	1 to 10 A/dm^2	1 to 45 A/dm^2	45 A/dm^2 max.
pH	4.0 to 4.5	4.0 to 4.5	4.0
Filtration	Continuous	Continuous	Continuous
Heating tool	heat exchanger	heat exchanger	heat exchanger

・pH control

Control the pH level of Nickel Sulfamate bath using following chemicals.

Add Sulfamic acid to decrease pH

Add Nickel Carbonate to rise pH



Attention for control of bath

1. The bath temperature is made into less than 70 °C. Hydrolysis is caused when bath temperature exceeds 70 °C, and formed Ammonium Sulfate deteriorates the film properties of the electrodeposit. Not to raise temperature locally, perform liquid circulation and use a heat exchanger.
2. Nickel containing sulfur with high solubility should be used for a positive plate.
   Nickel Chloride and a Nickel Bromide are used as an anode dissolving agent. When using anode dissolving agent in large quantities, Nickel Bromide shows the lower internal stress.
3. Inorganic and organic impurities rise internal stress, become brittle electrodeposition, and worsen film properties. Please be careful about the kinds of chemicals to use.

Example of performance

Please refer to the following data about Nickel Sulfamate plating and precision electroforming.

In addition, the operating conditions are as follows.

Nickel Sulfamate	250 to 650 g/L
Nickel Bromide	5 g/L
Boric acid	30 g/L
PITLESS S	5 mL/L
pH	4.0
Bath temperature	50±1 °C
Agitation	Mild agitation, Cathode locker
Current density	5 A/dm^2

1. Nickel Sulfamate concentration and internal stress, hardness

Internal stress shows the minimum at Nickel Sulfamate ($Ni(NH_2SO_3)_2 \cdot 4H_2O$) concentration of 450 g/L (Figs 1 and 2).

Hardness shows the minimum between 350 to 450 g/L (Fig. 3).

Fig.1 Relations of Concentration and Internal stress

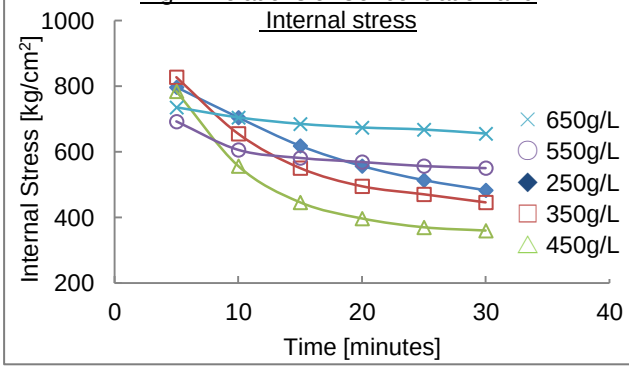


Fig.2 Relations of Concentration, plating thickness and Internal Stress

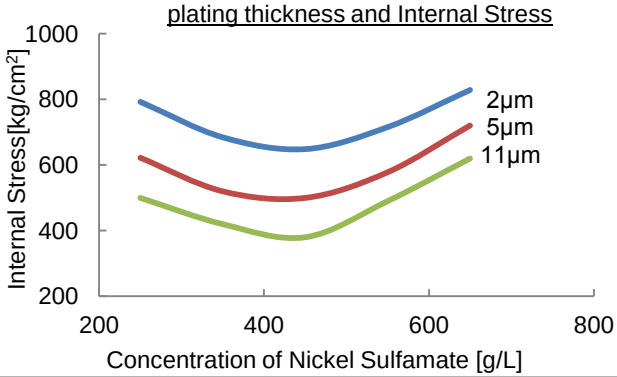
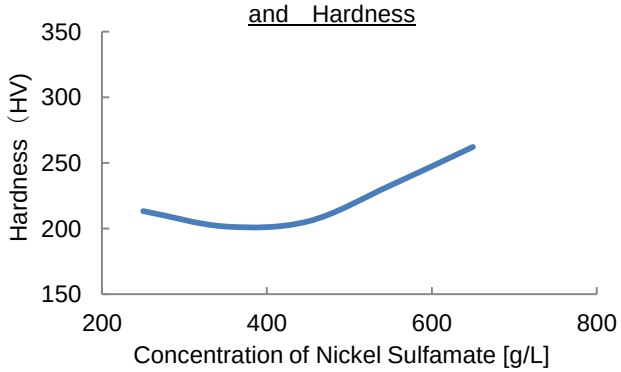


Fig.3 Relations of Concentration and Hardness



2. Cathode current density and internal stress, hardness

Initial internal stress rises with cathode current density rises. And internal stress becomes stable with plating film becomes thicker(Fig 4). Hardness decreases with cathode current density rises(Fig 5).

When performing electroforming etc., cathode current density is set up low at the early stage, and if it rises to predetermined cathode current density, the effect of the prevention from exfoliation under plating or the crack prevention at the time of a mold release can be expected.

Fig.4 Relations of Current dencity and Internal Stress

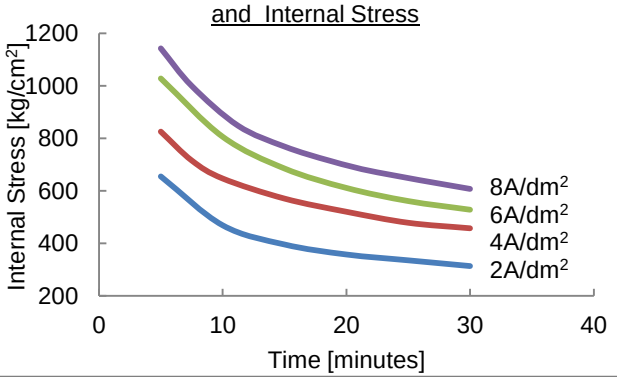
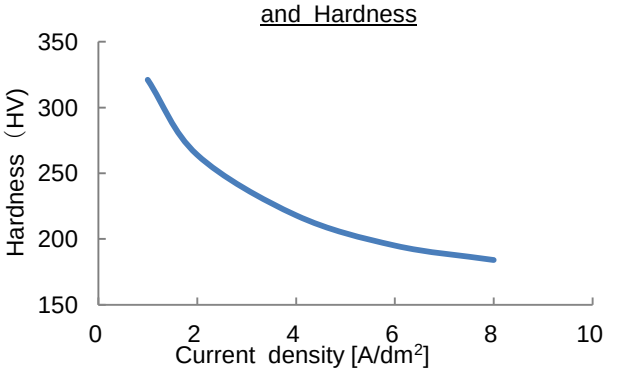


Fig.5 Relations of Current density and Hardness



3. Anode dissolving agent and internal stress, hardness

Nickel Chloride and a Nickel Bromide are used as an anode dissolving agent of Nickel Sulfamate bath. The influence that those chemicals give in plating film properties are as follows.

In low concentrations, internal stress is almost equivalent at addition of Nickel Chloride and addition of Nickel Bromide (Figs 6 and 7). However, to dissolve an anode reasonably and to stabilize a bath, it is necessary to make concentration of an anode dissolving agent higher. At the high concentration, addition of Nickel Bromide shows the lower internal stress than addition of Nickel Chloride.

Hardness is almost equivalent at addition of Nickel Chloride and addition of Nickel Bromide (Fig 8).

Fig.6 Relations of $NiCl_2$ addition amount and Internal Stress

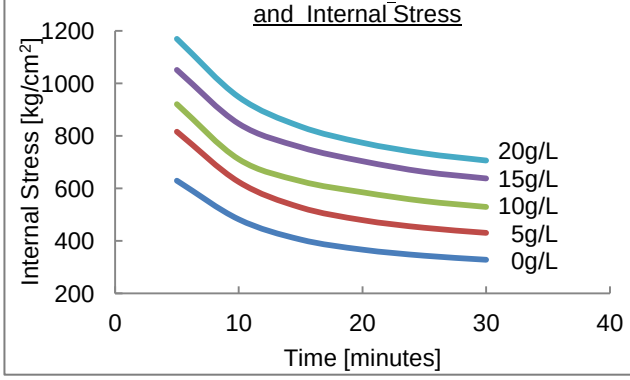


Fig.7 Relations of $NiBr_2$ addition amount and Internal Stress

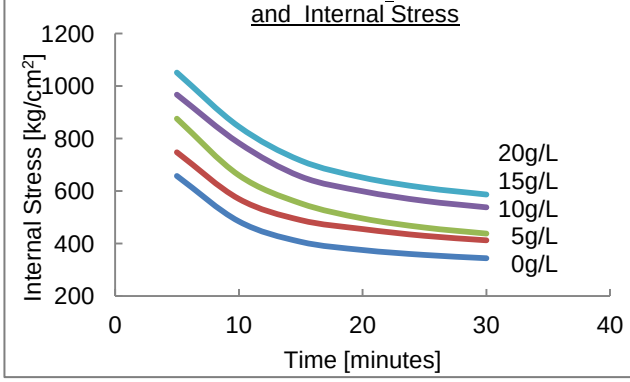
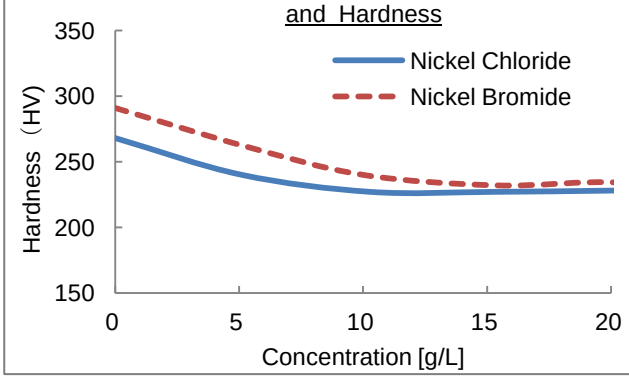


Fig.8 Relations of Anode dissolving agents and Hardness



4. Ammonium ion concentration and internal stress, hardness

By hydrolysis, Sulfamic acid generates Ammonium ion (NH^{4+}) and a Sulfate ion (SO_4^{2-}).

$$NH_2SO_3^- + H_2O \rightarrow NH_4^+ + SO_4^{2-}$$

These ions degrade plating film properties. Internal stress becomes highest between 2 to 4 g/L of $NH4^+$ concentration (Fig 9). Hardness rises with $NH4^+$ concentration increase (Fig 10) and becomes the brittle film. Appearance becomes the rough gray plating film.

Fig.9 Relations of NH_4^+, Plating thickness and Internal Stress

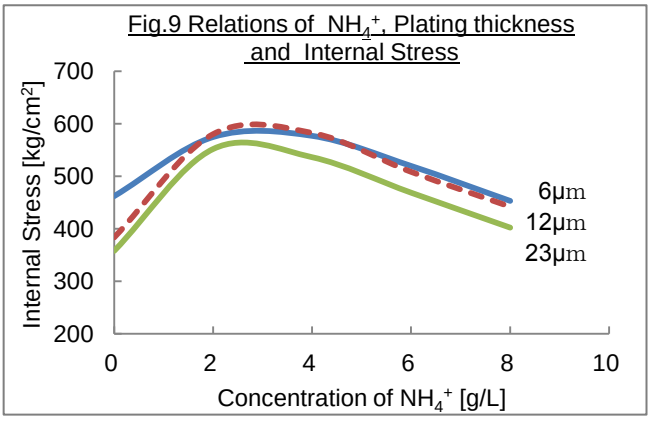
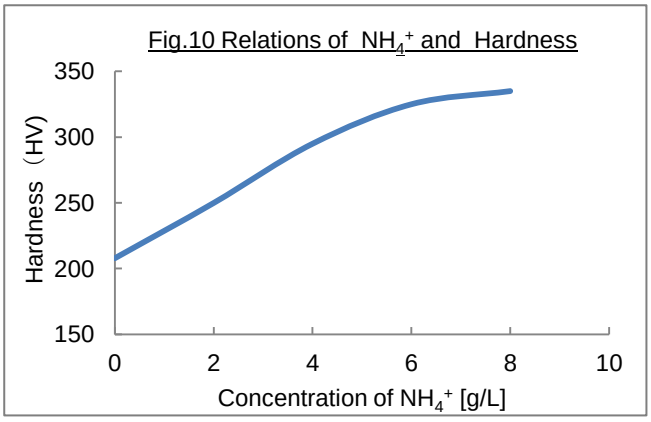


Fig.10 Relations of NH_4^+ and Hardness



In order to suppress hydrolysis, please work on condition of the following.

(1) Bath temperature : 70 °C or lower, (2) Avoid local heating, (3) pH4.0 or higher

By the work of bath temperature 50 °C and pH 4.0 or higher, the increases in NH_4^+ and SO_4^{2-} are very few.

5. Bath temperature and internal stress, hardness

Internal stress decreases with a temperature rise (Fig.11).

Hardness is stable from low temperature to 50°C. If temperature reaches 50 °C or more, hardness will rise (Fig.12).

Fig.11 Relations of Temperature and Internal Stress

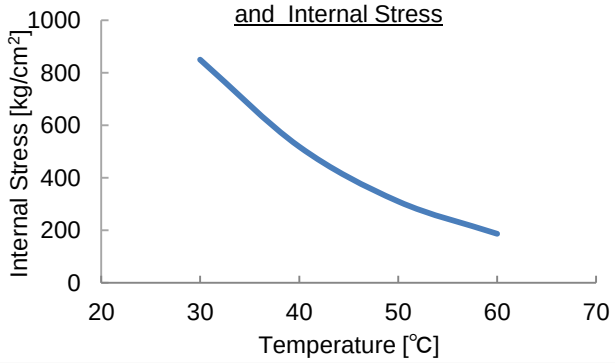
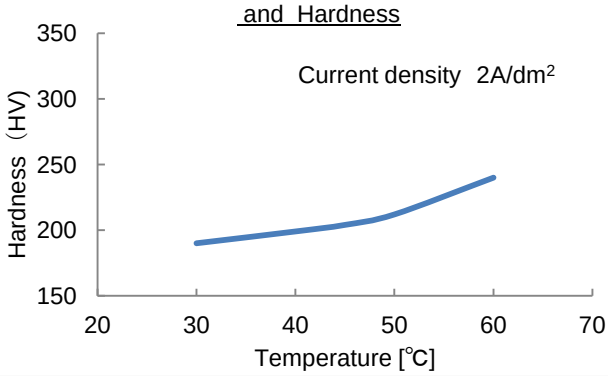


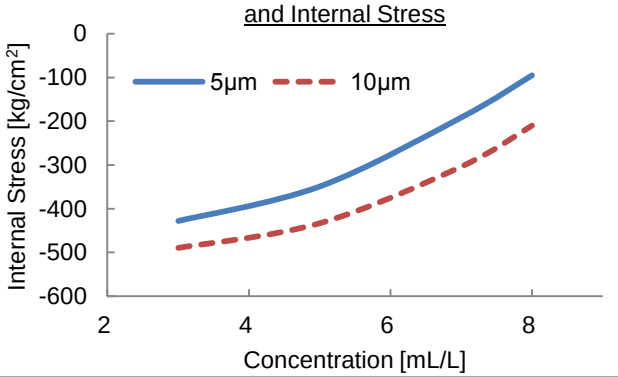
Fig.12 Relations of Temperature and Hardness



6. Effect of NSF-E (Additive agent only for Nickel Sulfamate)

If NSF-E is used, a plating film will become the hardness of 500 HV or more with compressive stress (Fig.13).

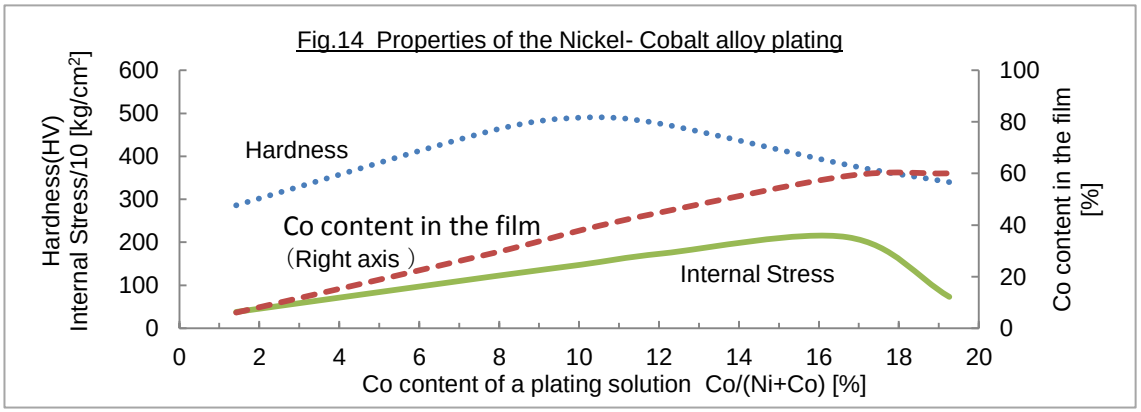
Fig.13 Relations of NSF-E addition amount and Internal Stress



7. Cobalt salt additives (to rise hardness)

In order to rise the hardness of plating film, Cobalt salt may be added to a Nickel Sulfamate plating bath. Usually, Cobalt Sulfamate is added. In this case, the Cobalt content in the plating solution is desirable to around 10%. Higher Cobalt content is accompanied by higher internal stress and lower hardness. Please keep in mind that a crack may occur(Fig.14).

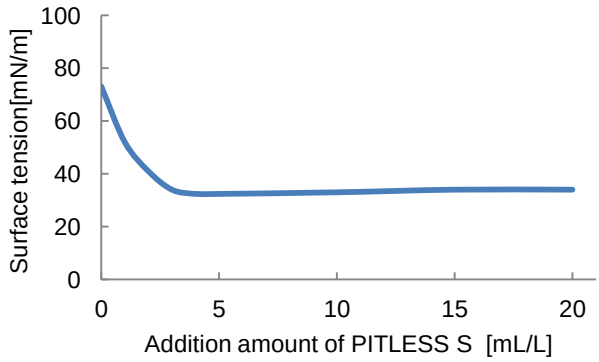
Fig.14 Properties of the Nickel- Cobalt alloy plating



8. Pit Prevention additive (PITLESS S)

Surface tension influences generating of a pit. PITLESS S can prevent pit generating(Fig 15).

Fig.15 Relations of PITLESS S addition amount and surface tension



Other Sulfamic salt

50% Cobalt Sulfamate Solution	$Co(NH_2SO_3)_2 \cdot 4H_2O$	
50% Lithium Sulfamate Solution	$LiNH_2SO_3$	
50% Manganese Sulfamate Solution	$Mn(NH_2SO_3)_2 \cdot 4H_2O$	
40% Ferrous Sulfamate Solution	$Fe(NH_2SO_3)_2 \cdot 5H_2O$	(Order Production)
35% Indium Sulfamate Solution	$In(NH_2SO_3)_3$	(Order Production)
40% Copper Sulfamate Solution	$Cu(NH_2SO_3)_2 \cdot 2H_2O$	(Order Production)

In addition, we have “**NSF series**” only for Nickel Sulfamate additive agent and " **NIKKA NONTACK** " mold releasing agent for electroforming.

Applications

1. Electronic component : Connector, Lead frame, Chip resistor etc.
2. Electroforming products : Metal mask, Resin mold, Stamper, Diamond cutter etc.

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