Xenolyte® Ni

Electroless Ni plating for all requirements

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Electroless Ni solutions for EN(EP)(IG) applications for pad and RDL housing

Xenolyte® Ni in ENEPIG, ENIG and ENEP applications

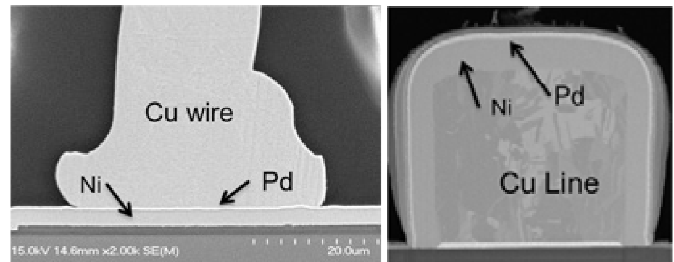
Atotech offers a variety of Xenolyte® Ni processes which are commonly used for Ni plating in ENEPIG (Ni/Pd/Au), ENIG (Ni/Au) and ENEP (Ni/Pd) deposits and are part of our Xenolyte® portfolio. This includes processes and products for cleaning and activation pre-treatment solutions, as well as plating chemistries for the electroless deposition of nickel, palladium, and gold on Cu and Al.

Main applications can be found in pad metallization and RDL shielding, where our Xenolyte® product suite enables hard, corrosion-free, and stress-minimized metal stacks to protect underlying active structures and provides a robust, stable, and low-resistance solder joint connection to the IC substrate.

The role of Ni in EN(EP)(IG) applications

For under bump metallization in semiconductor devices, electroless Ni/immersion Au (ENIG) or electroless Ni/electroless Pd/immersion Au (ENEPIG) processes are employed as standard final finish prior to wire bonding and solder application. In the stack, Ni acts as a barrier layer, preventing Cu from interacting with the other metals involved, particularly gold. Additionally, Ni (as well as Pd) prevent the Cu surface to be affected by tin in the solder. These barriers improve solderability immensely. As Ni is susceptible towards oxidation, an additional protection layer of Pd and/or Au is applied to cover the entire Ni surface.

EN(EP)(IG) is generally applied in power semiconductor applications.



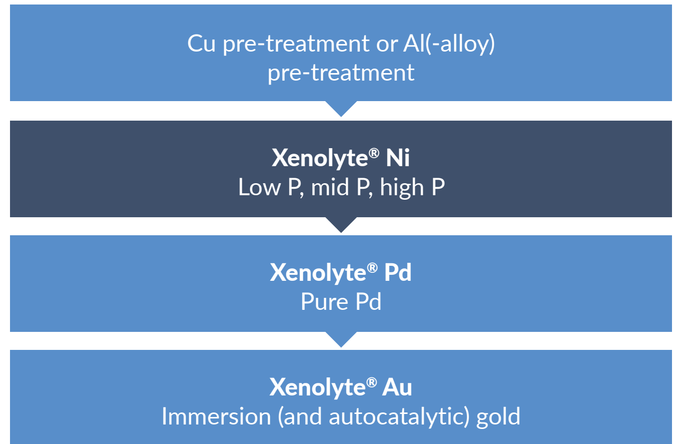


Figure 1:
Top: ENEP on pad for wire bonding
Bottom: Typical ENEPIG process scheme and available Atotech products

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Electroless Ni solutions for EN(EP)(IG) applications for pad and RDL housing

Product	Characteristics	Package
Xenolyte® Ni MC	Pb containing – fulfilling ROHS criteria; Mid. P (~ 6-8 w%); designed for RDL and pad	Universal mid. P Ni bath, suitable for pad and fine pitch applications
Xenolyte® Ni HP	Pb containing – fulfilling ROHS criteria; High P (~ 9.5-12 w%)	High P Ni bath, low tensile stress and high corrosion resistance; recommended for ENIG stacks
EXPT Xenolyte® Ni LF	Pb free; Mid. P (~ 8-9 w%)	Pb free mid. P Ni bath for pad application, low tensile stress
Xenolyte® Ni TR	Pb containing – fulfilling ROHS Nickel alloy with molybdenum and low phosphorous (1.5-4%) deposition	Ni-alloy for high temperature applications
Xenolyte® Ni RE	Pb containing – fulfilling ROHS criteria; Mid. P (~ 7-8 w%)	Low temp. bath, and less leach out effect from soldermask; RDL housing of < 1µm L/S Cu RDL

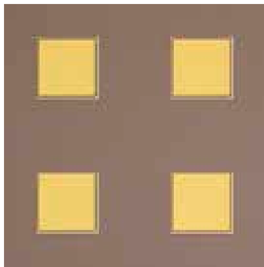

Figure 2:
ENEPIG pads on AlCu pad

Our broad variety of Xenolyte® Ni processes

We offer Xenolyte® Ni processes for low, mid and high phosphorous Ni alloys that can be tailored to fulfill customer requirements. As such, we offer Xenolyte® Ni MC as our universal mid. P Ni bath, which is suitable for pad and fine pitch applications. Due to the increased P content, our high P Xenolyte® Ni HP shows extremely low tensile stress and high corrosion resistance. Hence it is recommended for ENIG stacks. Additionally, we have developed a sustainable mid P alternative. As such, our EXPT Xenolyte® Ni LF shows excellent plating results and low tensile strengths of the deposits, without the use of the commonly contained lead.

The nickel deposits from Xenolte® Ni TR withstand even high temperature budgets of up to 450 °C during chip processing. It is the process of choice for high temperature soldering applications. Our Xenolyte® Ni RE process is designed for RDL housing applications, on which a thin Ni diffusion layer is deposited in order to protect fine Cu RDL lines against Cu migration into PI and Cu oxide formation during PI curing. Both effects reduce the effective cross section of Cu over time and result in higher resistivity for DC voltages as well as higher frequencies for small Cu line structures.

All our Xenolyte® Ni processes are RoHS compatible. The resulting Ni deposition layers exhibit low stress, high toughness/hardness, and low resistivity. They can hence be used in state-of-the-art, as well as next-generation semiconductor applications.

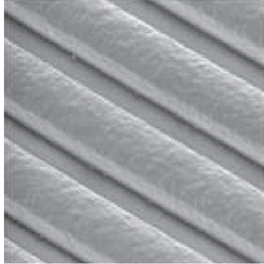

Figure 3:
Housing for Cu RDL with Ni/Pd for power application. Plated with Xenolyte® Ni MC

Xenolyte® Ni MC – mid. P Ni bath for universal applications

- Nickel/phosphorous deposition with 6-8 % P
- High-volume manufacturing proven
- High deposition speed
- Effective diffusion/migration barrier
- Low tensile stress
- Suitable for pad and fine pitch applications like Cu RDL
- RoHS compatible

Product overview

Xenolyte® Ni Make-Up SC	Xenolyte® Ni Reducer SC	Xenolyte® Ni Accelerator MP
Xenolyte® Ni Solution SC	Xenolyte® Ni Complexer SC I	Xenolyte® Ni Stabilizer C

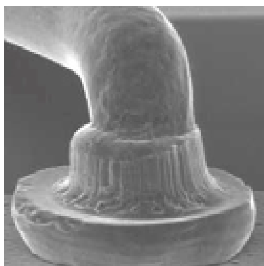

Figure 4:
ENIG stack for Cu wire bonding plated with Xenolyte® Ni HP

Xenolyte® Ni HP – high P Ni bath for universal applications

- Nickel/phosphorous deposition with 9.5-12 % P
- Extended bath life (2 MTO)
- Effective diffusion/migration barrier
- Low tensile stress
- High corrosion resistance
- Recommended for Ni + immersion Au stacks
- RoHS compatible

Product overview

Xenolyte® Ni Make-Up HP	Xenolyte® Ni Complexer HP	Xenolyte® Ni Reducer C
Xenolyte® Ni Solution HP	Xenolyte® Ni Stabilizer C	

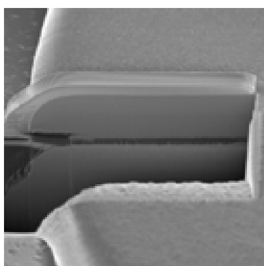

Figure 5:
Part of Ni/Au stack on AlCu wafer – plated with Xenolyte® Ni LF

Xenolyte® Ni LF – lead-free Ni bath for universal applications

- Nickel/phosphorous deposition with 7-9.5 % P
- Low stress deposits
- High deposition speed
- Effective diffusion/migration barrier
- Completely lead-free system

Product overview

Xenolyte® Ni Solution LF	Xenolyte® Ni Reducer LF	Xenolyte® Ni Additive LF
Xenolyte® Ni Complexer LF	Xenolyte® Ni Stabilizer LF	

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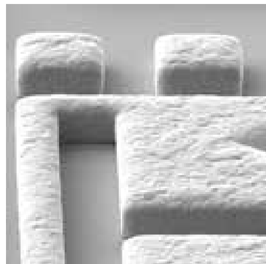

Figure 6:
RDL housing for high temperature applications – plated with Xenolyte® Ni TR

Xenolyte® Ni TR – Ni-alloy for high temperature applications

- Nickel alloy with molybdenum and low phosphorous (1.5-4%) deposition
- Effective diffusion/migration barrier
- Lower resistivity
- Suitable for high temperature soldering > 400°C
- Low stress post deposition and at higher temp
- High hardness and fracture toughness
- Long bath life up to 2 MTO
- RoHS compatible

Product overview

EXPT Xenolyte® Ni Make-Up TR	EXPT Xenolyte® Ni Additive TR	EXPT Xenolyte® Ni pH Correction TR
EXPT Xenolyte® Ni Replenisher TR	EXPT Xenolyte® Ni Reducer TR	EXPT Xenolyte® Ni Stabilizer TR

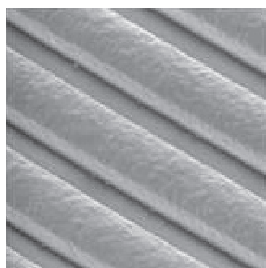

Figure 7:
RDL housing for dense Cu RDLs – plated with Xenolyte® Ni RE

Xenolyte® Ni RE – Ni bath for low temperature plating

- Nickel/phosphorous deposition with 7-9.5 % P
- Inhibition of Cu oxide formation and Cu migration into dielectric to prevent reduction in cross section
- Effective diffusion and migration barrier for dense RDLs
- High-temperature reliability (automotive: 5,000h/175°C)
- Can be tailored to prevent plating on bare Si
- Less leach out effects from solder mask
- Very good wire bond reliability
- High throughput due to batch processing
- RoHS compatible

Product overview

Xenolyte® Ni RE Make Up 1	Xenolyte® Ni RE Replenisher B	Xenolyte® Ni Reducer C
Xenolyte® Ni RE Make Up 2	Xenolyte® Ni RE Replenisher D	Xenolyte® Ni Stabilizer C
Xenolyte® Ni RE Replenisher A	Xenolyte® Ni RE Replenisher E	

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