

ID No. 693	Product/Process Change Notification	Date 03.09.2019
Product		Ordering Code
ALS3-E Rel.2.*		L30960N312*A1*
ALS3-E Rel.2.*		L30960N312*A2*
ALS3-US Rel.2.*		L30960N313*A1*
ALS3-US Rel.2.*		L30960N313*A2*
ALS3-US Rel.2.*		L30960N313*B1*
ALS3-C Rel.3		L30960N318*A1*
ALS3-C Rel.3		L30960N318*B1*
ALS3-C Rel.3		L30960N318*B3*
ALS3-US Rel3		L30960N348*A3*
ALS3-US Rel4		L30960N348*A4*
ALS3-US Rel3		L30960N348*B3*
ALS3-US Rel4		L30960N348B4*
ALS3-E Rel3		L30960N349*A3*
ALS3-E Rel4		L30960N3490A4*
ALS3-E Rel4		L30960N3490D4*
Ordering Code changes:		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Product	New Ordering Code	

Reason of Change:

- | | |
|---|---|
| <input type="checkbox"/> Technical requirement | <input checked="" type="checkbox"/> Change of production process/logistical changes |
| <input type="checkbox"/> Customer requirement | <input checked="" type="checkbox"/> Location of production moved |
| <input checked="" type="checkbox"/> Quality improvement | <input type="checkbox"/> Other: |

Description of change:	<p>Memory supplier Micron has announced to implement two changes that will become applicable with change of the year 2020:</p> <ol style="list-style-type: none"> 1. Move back end production site from Korea to Taiwan. This Taiwan based production site is not new but a well-established one. Gemalto M2M is already been sourcing components from there, for other modules than ALS3. 2. Change bond pad metallization from Nickel Palladium (NiPd) bond pad to Aluminium (Al). The change will not impact the final packaged product. Other DRAM/NAND technologies at the Taiwan fab site use the Al bond pad process and it is proven to be more robust than before NiPd. – see attachment <p>Both silicon dies (FLASH and RAM) remain untouched.</p>
Availability of modules ex Gemalto M2M warehouse:	CW04/2020
Timing note:	If Gemalto M2M GmbH does not receive a notification to the contrary within a period of 6 weeks, Gemalto M2M GmbH assumes that the customer agrees to the change.

Quality assurance measurements:

The new version fulfils all internal test requirements according to our Quality Management process and philosophy.

03.09.2019

03.09.2019

X *i. Frank Ryll*

X *i. Joerg Erdmann*

F.Ryll

PLM

Signiert von: Frank Ryll 10015116

J.Erdmann

Head of QM

Signed by: Joerg Erdmann 10015214

Attachments:



PCN 33252 AIM2
Customer presentatio

↓ **Customer acknowledgment (see next page)** ↓

Customer Confirmation

Company Name:	
Address:	
First Sample Report (FSR) required	<input type="checkbox"/> YES <input type="checkbox"/> NO
Required number of First Samples Address for FSR and samples:	
Allowed to ship old and new products for an interim period	<input type="checkbox"/> YES <input type="checkbox"/> NO
Use up permissible of	<input type="checkbox"/> Products <input type="checkbox"/> Software
Special requirements for first shipment Which?	<input type="checkbox"/> YES <input type="checkbox"/> NO
Remarks:	

Customer Feedback for Product/Process Changes *)

Company Name: Customer Responsible/Name: Department: Date:	
With your signature, in this field you confirm that you accept and release the Product/Process Changes: Signature:	If NO, please give a brief reason: Signature:

***) Dear Customer, kindly note that without your written confirmation, Gemalto M2M is not allowed to ship the modules with the described changes. In case you feel impelled to sign in the NO box, please contact your Gemalto M2M Sales representative in order to clarify coming shipments.**

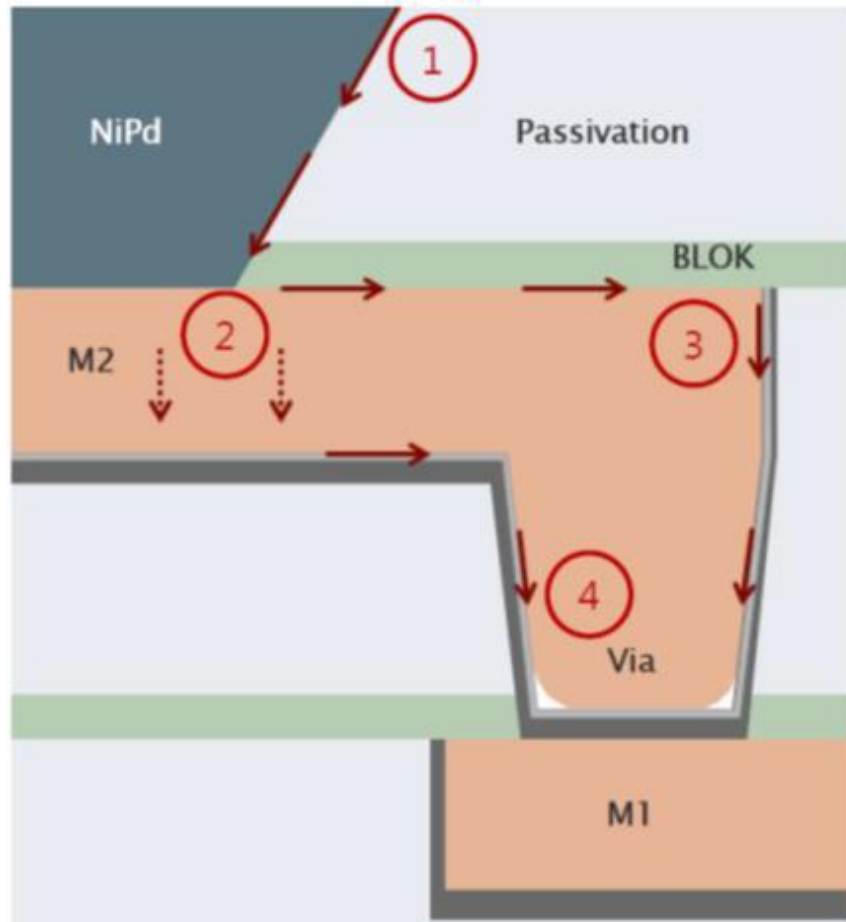
PCN to replace NiPd with Al M2

60/70 Series NAND Devices

Background

- Legacy 60/70 series NAND devices use an obsolete Nickel Palladium (NiPd) bond pad process
- Bond pad corrosion & via void failure mechanism is an inherent weakness in the NiPd bond pad process
- NiPd is obsolete and process equipment is more difficult to maintain
- This PCN replaces the NiPd bond pad process with newer and more robust Aluminum (Al) process
 - Al has been employed since 80 series NAND devices
 - Al is used on DRAM as well as later technology NAND devices
 - Al eliminates bond pad corrosion & via void failure mechanism

Failure Mechanism Behind NiPd Bond Pad Via Void



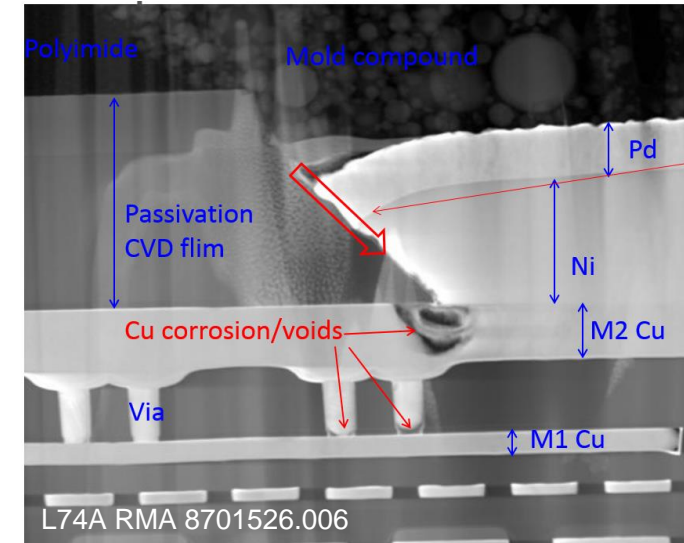
1. Corrosive agent, such as Chlorine, combined with a moisture source travels between the NiPd and Passivation until it reaches the M2, copper, interface.
2. Corrosive mixture will continue to travel BLOK/Cu along interface until it hits a Ta (grey) interface.
3. Ta will oxidize forming TaOx along interface between copper and metal 2 dielectric.
4. After significant oxidation has occurred the via will begin to void.
5. This is because copper will void in most stressful location, the corners, when interface is compromised.

Note: Moisture is commonly introduced in manufacturing processes in the form of DI water, though without the introduction of a corrosive agent this will be non-reactive.

Process Improvement

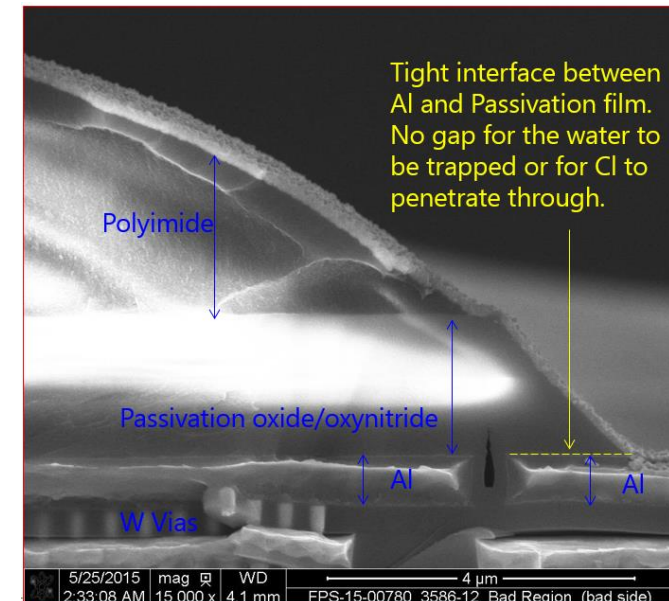
- NiPd process is a legacy process
 - Electroless plating process highly depends on the quality of incoming chemicals
 - Difficult process to control
 - Results in a low PPM Ni/Pd seam causing voids
- NiPd was replaced by superior Al M2 on newer technologies
 - All DRAM (60s+) have used Al process since 2009
 - 80s NAND and subsequent nodes including M70A use Al
 - Seam voiding has been eliminated on Al M2
- Al M2 is a clear improvement to NiPd
 - Al M2 has no seam or gap between bond pad and passivation layers
 - Al M2 has been used for several years with out a single instance of bond pad failure or voiding
 - Micron will convert remaining 60/70 series NAND devices to Al M2

Ni/Pd bondpad & Failure Mechanism



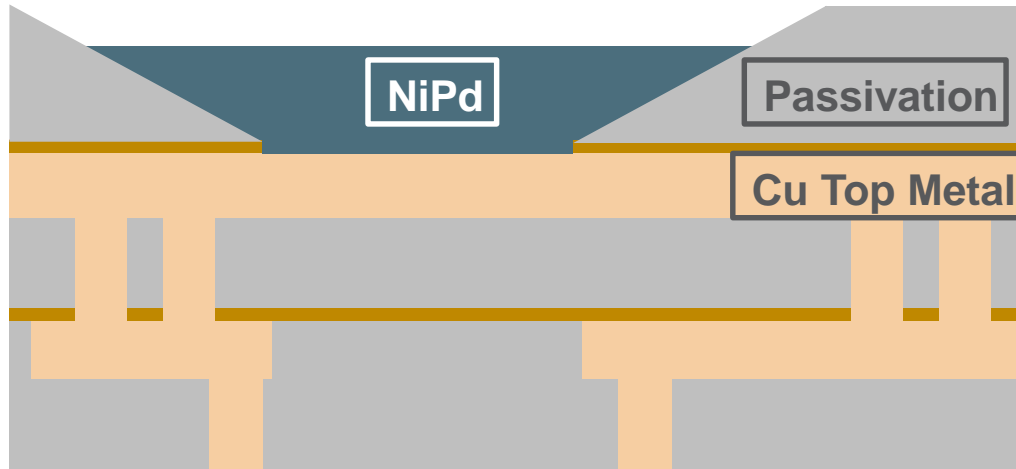
This interface (seam/gap) between Ni/Pd film and passivation allows water to be trapped and Cl to penetrate through and get to Cu.

M2-Al bondpad (no seam)



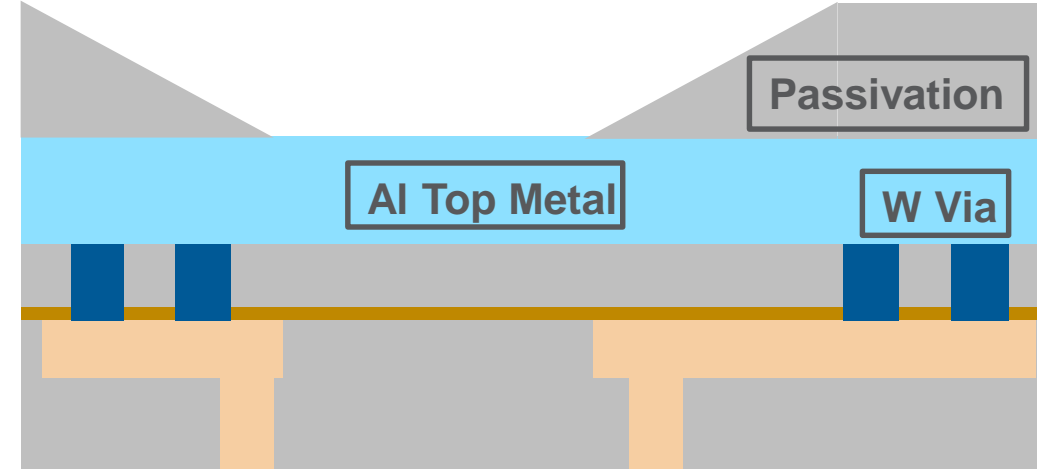
70s NAND ALM2 Conversion BEOL CD Changes

Cu Top Metal Process Flow



NiPd process has seam that creates a path for moisture to copper top metal

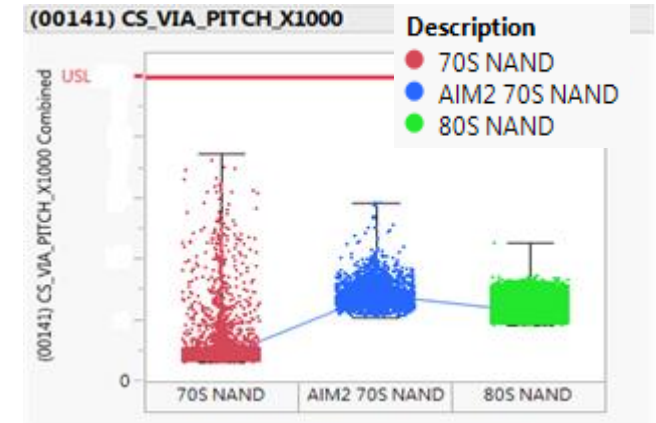
Al Top Metal Process Flow



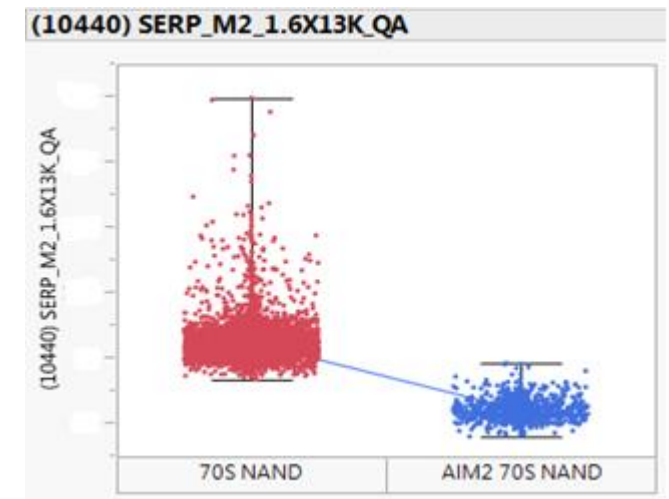
Al top metal eliminates the moisture path to copper

Key differences

- No difference in the lower layers of NAND device
- AI M2 has minimal electrical differences
 - AI M2 Via resistance is slightly higher
 - But consistent with other 80s AI M2 products
- AI M2 metal layer resistance decreases 19%



AI M2 via resistance



AI M2 metal resistance

Qualification Timeline

- Efforts to begin qualification and conversion to Al metal for 60/70 series NAND devices have already begun
- Initial qualification samples will be available starting August 2018
- Customers will be provided with PCN notification and any qualification material needed for evaluation
- These are initial estimates based on qualification timeline and tooling/capacity for Al metal2 and are subject to adjustment

