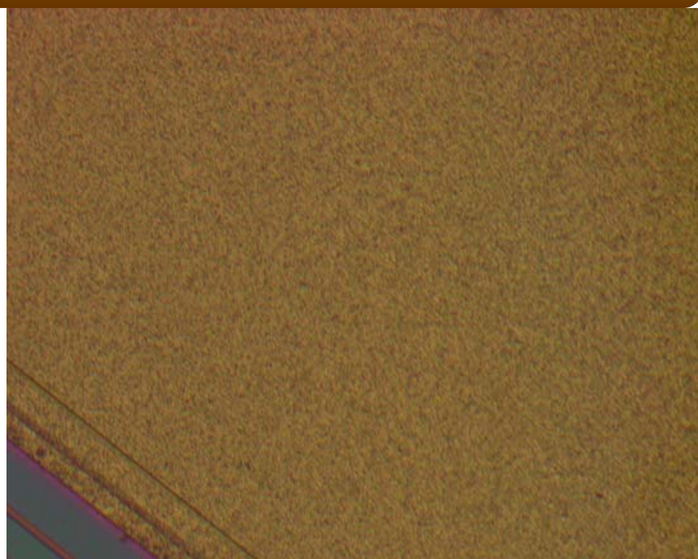
Stapleton Technologies Inc.

Al/NiP/Au
Cu/NiP/Au



UBM Process Sequence, Nickel/Gold

Sequence Ranges	Description	Applications	Features
1010-1019	Base Metal: Aluminum Acid Zincate Process	UBM on thin alloy Al pads,	30nm etch for pretreat-ment process
1020-1029	Base Metal: Aluminum Alkaline Zincate	UBM on 1.5+ um Al pads,	300-500nm etch during pretreatment
1030-1039	Base Metal: Copper	UBM on thin Cu pads, through hole metalization,	Diffusion barrier for gold
1040-1049	Base Metal: Silicon	Direct Metalization of Silicon and CoNi silicide Ohmic contacts	Ohmic Contact
1050-1059	Base Metal: Oxide	Wafer Level Self Assembly of circuits and devices.	Molecular Metalization

Scope:

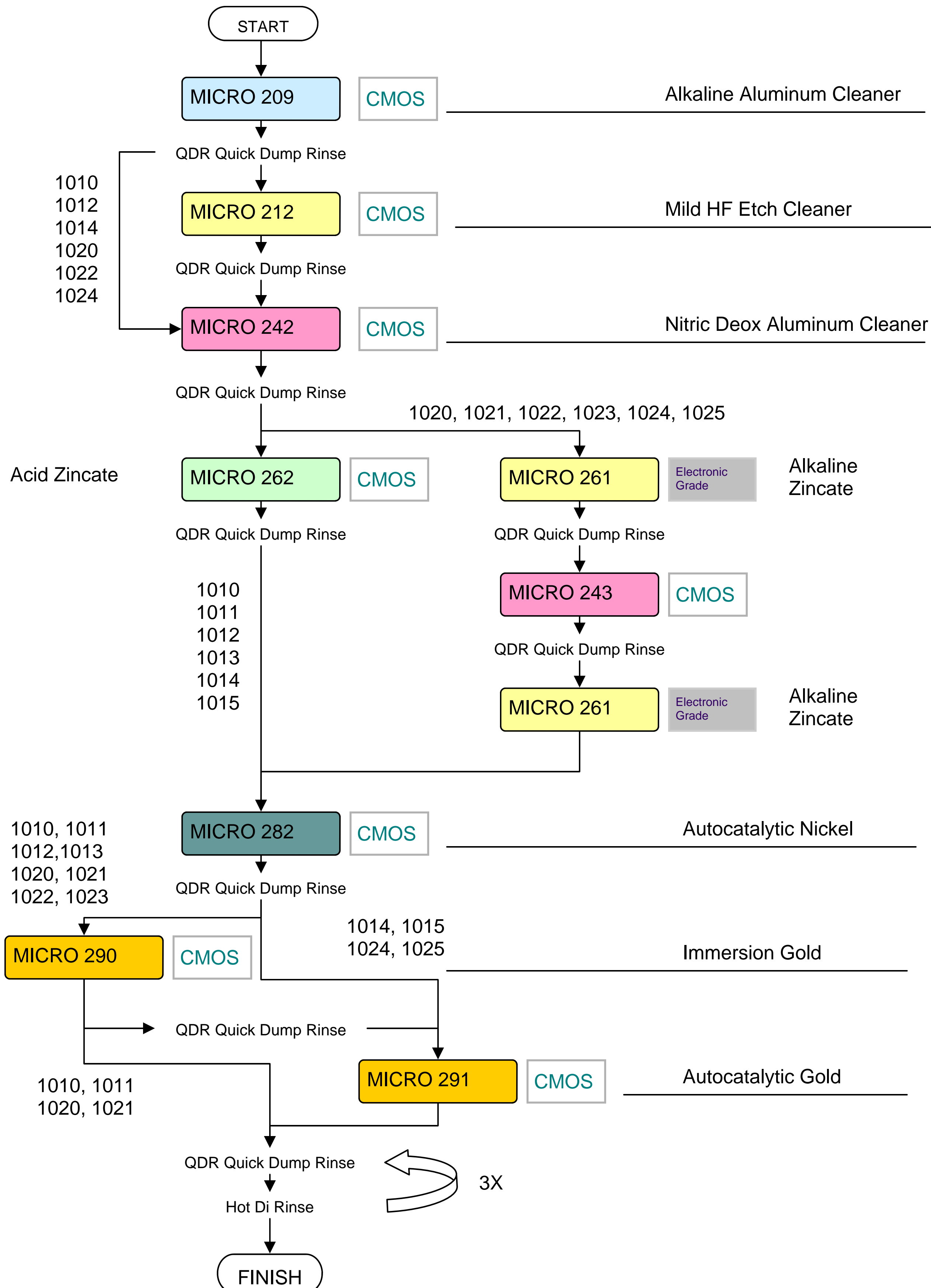
Aqueous processing of wafers requires several steps to prepare the surface for metalization. These steps alter the surface by removing contaminates and activating the surface with an ion that initiates the reduction reaction.

Unique processes have been assembled into a sequence (set) that perform this function. Processes are also formulated to be compatible with each other to minimize the effects of dragover (process cross contamination) when using a specific sequence.

Time, temperature, rinsing, thickness, trace element levels, concentrations and other factors all play a critical role in aqueous wafer metalization.

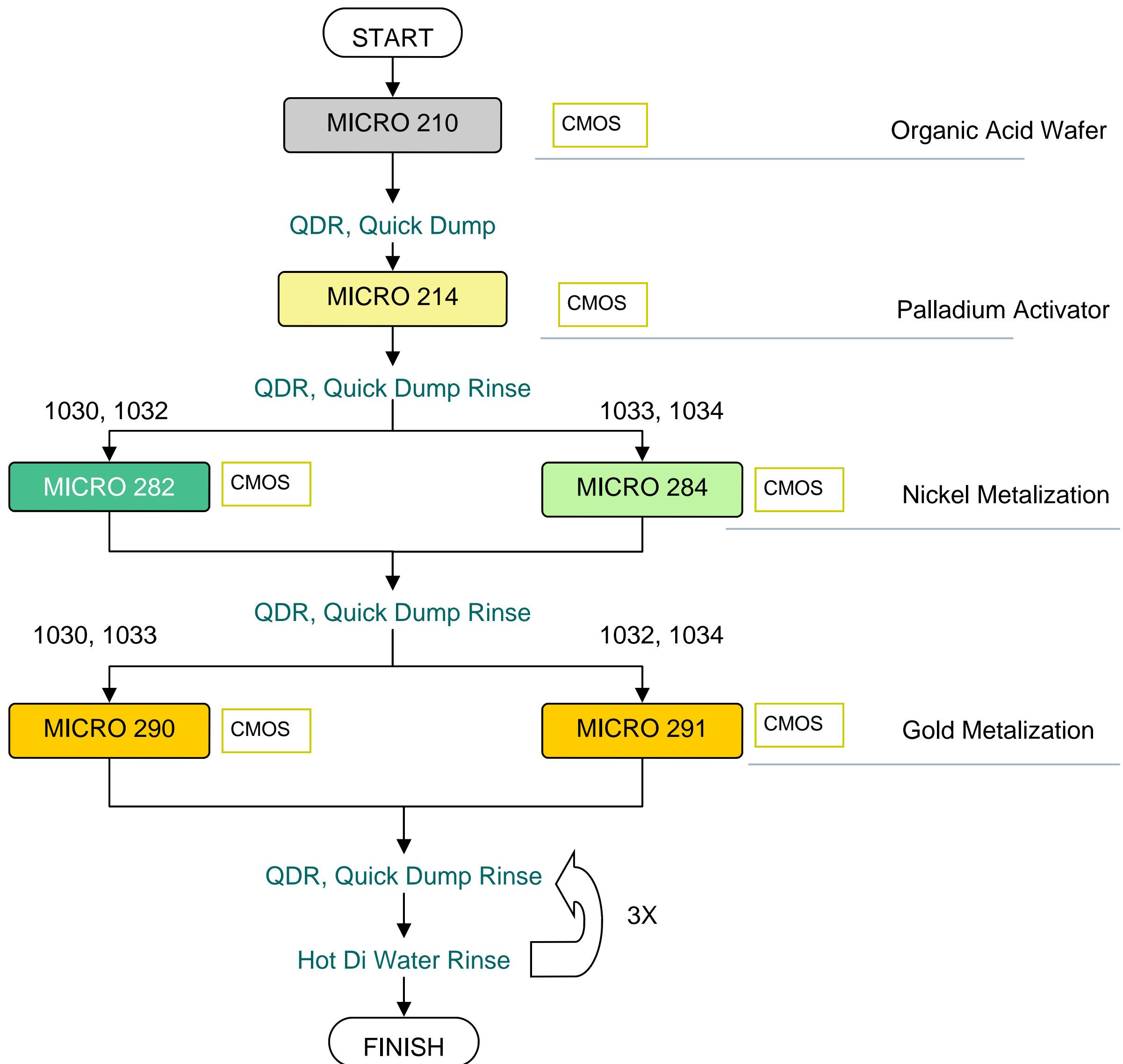
This brief document describes many of the sequences and provides guidelines on selecting and operating these processes.

Aluminum Alloys Processing, Sequences 1010-1029



Mobius Solutions

Copper Alloy Processing, Sequence 1030-1039



The process sequences described on these two pages summarizes the different methods of metalizing Aluminum and Copper with nickel and gold for solder and wirebond interconnect.

The numbers are used to describe different sequences and provides for a management of the wafer processing and a means of organizing the tooling and process management programs.

The Aluminum processes are divided into acid and alkaline zincate process. Wafers that use pure Aluminum require the more aggressive alkaline process to deposit Aluminum. Alloy silicon copper aluminum is more active and can use the acid zincate. These considerations require some discussion before the sequence can be selected. Other factors like the temperature limits for resist and alkaline pH limits must be considered.

Other processes are available that extend the range of processing, reducing the operating temperature and lowering the pH.

Another important consideration is the presence of pN junctions on the wafer that may be sensitive to light. This is almost always the case with the need to process in very low light to complete darkness. This factor must be incorporated into the process system to insure uniform thickness.

Many of these processes are formulated to be less than 1 ppm of sodium and potassium with most less than 10ppm. This represents a significant ongoing effort to achieve CMOS quality.

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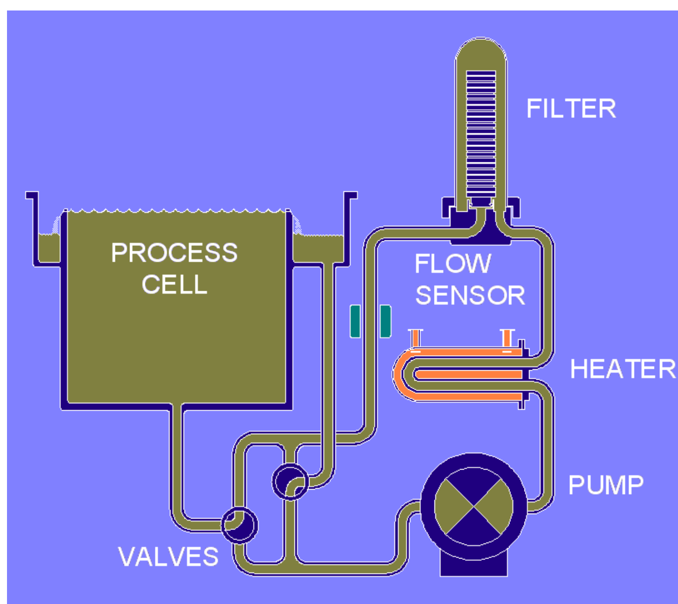
UBM Tooling

These processes use specialized wafer processing equipment provided by Technic. The tooling incorporates several key functions for each process.

This brief section describes the different features and organizes them into process cell types to help describe the physical processing requirements.



Tooling Matrix

Type	Cell Material (1)	Pump Type (2)	Heater Type (3)	Filter	Titrator / Analyzer (4)
A	PFA	Pneumatic	PVDF (20-75C)	0.1—0.5 um	
AT	PFA	Pneumatic	PVDF (20-75C)	0.1—0.5 um	Applikon 2018, 2040
B	PFA	Centrifugal	PVDF (20-75C)	0.1—0.5 um	
BT	PFA	Centrifugal	PVDF (20-75C)	0.1—0.5 um	Applikon 2018, 2040
C	PFA	Pneumatic	SS316 (20-99C)	0.1—0.5 um	
CT	PFA	Pneumatic	SS316 (20-99C)	0.1—0.5 um	Applikon 2018, 2040
D	PFA	Centrifugal	SS316 (20-99C)	0.1—0.5 um	
DT	PFA	Centrifugal	SS316 (20-99C)	0.1—0.5 um	Applikon 2018, 2040
E	SS316	Pneumatic	SS316 (20-99C)	0.1—0.5 um	
ET	SS316	Pneumatic	SS316 (20-99C)	0.1—0.5 um	Applikon 2018, 2040
F	SS316	Centrifugal	SS316 (20-99C)	0.1—0.5 um	
FT	SS316	Centrifugal	SS316 (20-99C)	0.1—0.5 um	Applikon 2018, 2040
QDR	PFA	NA	NA	NA	Conductivity
HDI	PFA	Centrifugal	SS316 (75-90C)	0.1—0.5 um	Conductivity

(1) Cell Materials, All cells use a constant level feature using an overflow weir. These cells are designed to alternate the flow during stand-by insuring that the particles that collect in the working chamber are removed. Different materials are needed for chemical compatibility.

(2) Pump Types, There two types of pumps used for processing, 1) Pneumatic and 2) centrifugal. Centrifugal pumps can be sealless or have double mechanical seals with Di water flush. The size and process determines which type of pumps is used. Generally gold solutions are sensitive to air and should not use sealless pumps.

(3) Heater Type, Heaters are selected for heat density and material of construction. Generally, SS316 heaters are used where high process temperatures are needed. PVDF is used where SS316 is not compatible with the process. In all cases these heaters use low pressure steam as the heating source.

(4) Titrator/Analyzer, These units are available to monitor specific process conditions and maintain the process concentration. The use of these instruments is dependent on the amount of processing per day.

MOBIUS SOLUTIONS Process List

Process Description	Formulation	Function	Parameters	Tool Type
MICRO 301	Backside Mask	Prevents metalization on the back of a wafer.	Air Cured in 4 hours, Brush, Dip, Spray	
MICRO 209	Cleaner, TMAH, TEA	Clean Aluminum surface and wet metal areas.	25-40C, Alkaline Cleaner	A,B
MICRO 210	Cleaner, Organic Acid	Cleans Aluminum and copper surfaces	25-40C, Acid Cleaner	A,B
MICRO 212	Etch Cleaner, HF	Micro etch of Aluminum for Si surface contamination	25-40C, Acid Etch	A,B
MICRO 214	Palladium Seed	Deposits a monolayer of Pd onto the copper or other non-catalytic surface	25-35C, 30-60 sec	A,AT
MICRO 242	DEOX, 15% HNO3,	Cleans aluminum removing Al2O3	22C, 60 sec, 0.1um filter	A,AT
MICRO 261	Zinc, Nickel and Iron	Alkaline Zincate, Exchanges a monolayer of Al on the surface for Zn and Ni	26C, 35-45 sec, 0.5um filter	A,AT
MICRO 262	Zinc and Nickel fluoborate	Acid Zincate, Exchanges a monolayer of Al on the surface for Zn and Ni	26C, 90 sec, 0.1um filter	A,AT
MICRO 282	Nickel hypophosphite and buffer acids, TMAH ...	Nickel Metalization 8-13%P	83C, 200-800 sec, 0.2um filter	D,DT
MICRO 284	Nickel hypophosphite and buffer acids, TMAH ...	Nickel Metalization 11-13%P	83C, 200-800 sec, 0.2um filter	D,DT
MICRO 290	Ammonium Gold Cyanide	Gold Metalization	60C, 900 sec, 0.1um filter	A,AT
MICRO 291	Ammonium Gold sulfite	Gold Metalization	60C, 180 sec, 0.1um filter	A,AT

Selecting the Process Sequence

There are several factors that effect the decision and control the process. These are summarized in general on this page. For a complete discussion on these topics contact Technic Mobius Solutions experts.

Process Considerations

1. Determine the base metal composition including all the major and minor elements.

   A. Aluminum, 1100 Pure
   B. Aluminum, 2024, 6061 Alloy Silicon Copper
   C. Copper
   D. Silicon
   E. Silicon Dioxide, Polyamide,

2. Identify the limits of pH and temperature for the wafer.

3. Identify the thickness of base material and any limitations on the etching.

4. Identify the wafer thickness and need for backside masking.

Tooling Considerations

1. How many wafers per 8 hour day? This will determine if the tooling is for prototype or production. Generally a manual system is limited to about 100 wafers per day.
2. Are the wafers being metalized on the front and back at the same time? This will control the loading and fixture usage effecting the production.
3. What is the thickness of nickel and gold on the wafer? The thickness of nickel is generally 2.0um for underfilled devices and over 4.0um for soldered and exposed pads. Gold is 0.1um for solder interconnects and 0.3-2um for wirebond interconnects. This information controls the processing time and number of stations effecting the production.
4. Are there any limitations to waste water treatment? The typical process uses multiple three stage dump rinses which can lead to a significant amount of waste water. Some sequences have less steps and therefore less waste water to processes. A typical 42 liter PFA molded tank system can use 1000 liter every 15 minutes.

Operating Considerations

1. The processes use complex chemistry and require some initial evaluation to insure the processes are functioning correctly. Tooling generally will indicate that all processes are within range and the equipment is functioning correctly. Processes can be evaluated off-line or on-line using analyzers. In an ideal system, the processes are only stopped for scheduled replacement based on an understanding of the yield and wafer performance.
2. The nickel processes require periodic cleaning to remove metal deposits. This is accomplished by transferring the working solution to another cell while the dirty cell is cleaned with a 25% Nitric acid solution. This takes about 4 hours. Tooling should have a minimum of two nickel metalization cells to be able to metalize wafers at all times.
3. Wafers that have pN junctions must be processed in darkness. This requires that the processes be covered at all times so that light is not present in any of the processes.
4. Serious consideration for automated operations over manual must be made before ordering tooling. Generally the automated processing is significantly lower cost of operations when you consider all the factors.