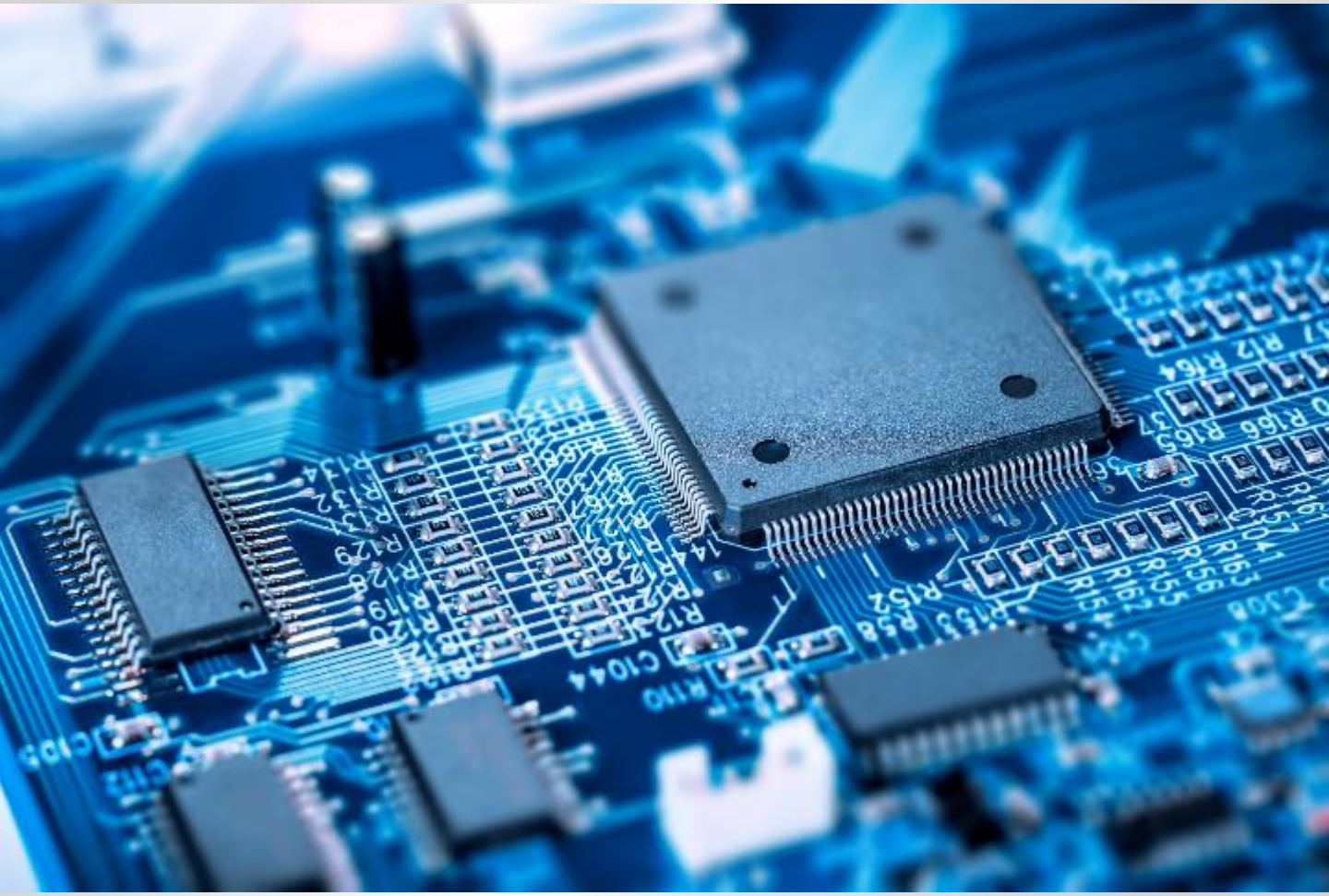
EXTRUDE HONE®

SHAPING YOUR FUTURE
Semiconductor Applications by Extrude Hone



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MAKING THE WORLD SAFER, HEALTHIER & MORE PRODUCTIVE®

Semiconductor Applications by Extrude Hone

Designed by us

Extrude Hone has been in business since the 1960's , building on its proprietary technology extrude honing, which has developed into what it is more commonly know as today - Abrasive Flow Machining (AFM) – a well-proven process to polish the surface of parts and deburr applicable to many industries. One interesting variation of AFM is MICROFLOW, which can be used in applications involving micro holes. Along the way additional technologies have been added to the portfolio offering, like Thermal Deburring (TEM) and Electrochemical Machining (ECM).

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Various applications to support a demanding industry

Whatever we do for the semiconductor industry it is about helping to improve surface and remove micro-burrs.

Mechanical components involved in wafer processing systems are critical. These components need first to be free of particles left during the machining operations and second to have top notch quality geometry and surface quality.

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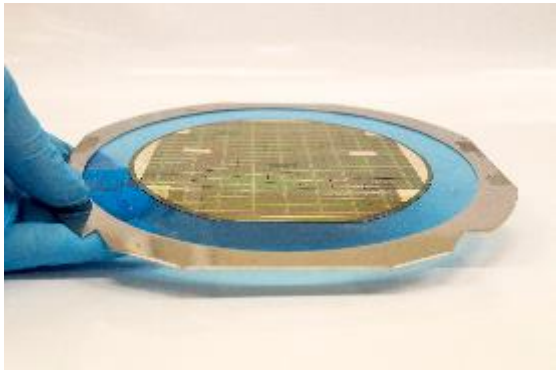
This is where Extrude Hone can deliver superior value offering finishing process that will guarantee parts free of micro-burrs for machined parts or free of powder particles in the case of printed parts while delivering surface enhancement.

The Applications in a nutshell

Some of the semiconductor champions:

- Lead frame dies
- Wafer showerhead plate
- Sputtering targets
- Gas flow path in High purity manifolds, valves, fittings
- Nozzle (ceramic)



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We started with Abrasive Flow Machining, AFM. Thousands of Holes in the **Gas Showerhead** can be deburred, cleaned and polished all at the same time in one cycle of AFM, by using the appropriate media developed by Extrude Hone.

Basically, the type of AFM application is driving the choice of the equipment required. The application, but also the size of the part, and / or the size of the channel to be processed are key points.

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To ensure mirror polishing of complex outer shape or flat surfaces we have developed ORBITEX, a variation of AFM technology. It started with polishing race engine piston top surface but also glass molds and rims. Some customers found the process suitable for various niche applications across various industries including semiconductor. Prime example – polishing of **Sputtering Targets**.

In addition, Extrude Hone developed flow tuning systems for very specific small holes geometries, with the so called MICROFLOW process, another AFM variation for leveraging the use of a viscoelastic media loaded with very small grits. This can be used for Nozzles.

Surface matters, Finishing Methods as well

Extrude Hone finishing methods

Depending your finishing requirements, the component geometry, material and the manufacturing process we have solutions for you.

Surface Finishing

Abrasive Flow Machining is still the way to go when you want to improve surface especially in hard-to-reach areas.. It's the process suitable by nature for additive intricate passageways requiring surface improvement. AFM will provide mirror like finishes down to 5 µin. Ra / 0.125µm for fittings or down to 1 µin. Ra / 0.025µm for lead frame die.

Parts suitable for AFM: Lead Frame Die, Showerhead / FacePlate, Manifolds, Fittings Valves used in gas flow path, Ceramic Nozzles.

ORBITEX this is a variation of Abrasive Flow Machining (AFM) but the media is moved in and out a bowl while a head supporting the workpiece will plunge in the media bowl while animated by an oscillating movement. ORBITEX comes in different sizes to fit the workpiece size. Super high end finishing surfaces can be achieved without the micro scratches common in traditional AFM applications.

Parts suitable for ORBITEX: Sputtering Target.

MICROFLOW is a process dedicated to flow tuning but also for surface improvement of micro holes, it is now available in a high flow variation which open up new applications.

Parts Suitable for MicroFlow: Nozzles with micro holes.

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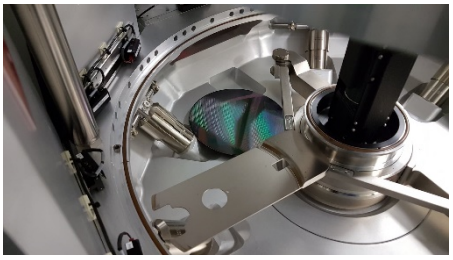

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Lead frame dies

Solution for polishing hard-to-reach areas on intricate dies where highest precision is required.

All industries, required semiconductors, they are everywhere. Lead frame are a thin layer of metal to which semiconductors are attached. You can find lead frames in most of the semiconductor packages. It's a mass volume production.

Lead frame are manufactured using roll of long stripe of plated material. The stripe of metal is perforated on each side with holes used to guide and advance it though the progressive stamping process. Stamping machines are made of an assembly of progressive punch sets. The dies and punch sets mostly made of cemented carbide are of high precision. You can have geometries within the quarter of a millimeter for which surface should be as good as possible.

Historically Abrasive Flow Machining (AFM) has been invented first with die polishing in mind.

When the lead frame industry is looking to better product, they eyes to superior tooling, which means superior dies.

Abrasive Flow Machining is perfectly suited to improve the surface roughness for high precision dies.

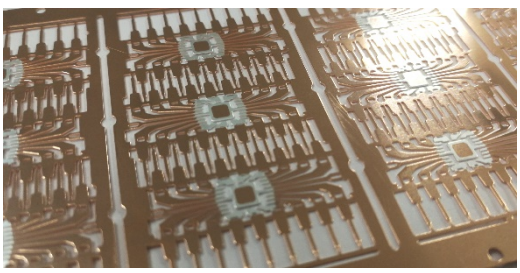
CHALLENGE

- Improving surfaces within the lead frame die passages

BENEFITS

- Short time cycle
- Improve stress resistance and cleanliness
- Improve roughness from Ra 0.075µm (3µin) to Ra 0.025µm (1µin) within die tiny passages

Source: Everloy Cemented Carbide Tools



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Wafer showerhead Plate

Making showerhead faceplate better

The wafer processing system is built to accurately depositing layers of material on a wafer's surface within a reaction chamber.

Processes like Atomic Layer deposition (ALD) or Chemical Layer Deposition (CVD) use a gas distribution showerhead for supplying gases to the reaction chamber.

The processes will deposit a film or develop an etch reaction to remove material from the wafer.

Showerhead used for gas deposition includes plates with thousands of thin holes. The main issue in manufacturing such plate is to remove the burrs located inside each of these thousand holes.

Deburring manually these holes is very tedious, time-consuming and a real challenge quality wise. In addition, each manufacturer will develop specific designs that creates more challenges. Hand deburring process generates some Foreign Object Debris (from deburring and cleaning) that will drive rejection up during control driving more rework and still too many scrap.

Abrasive Flow Machining by Extrude Hone is the solution to deburr a whole faceplate in a single operation. The result performance also depends on specific engineered media.

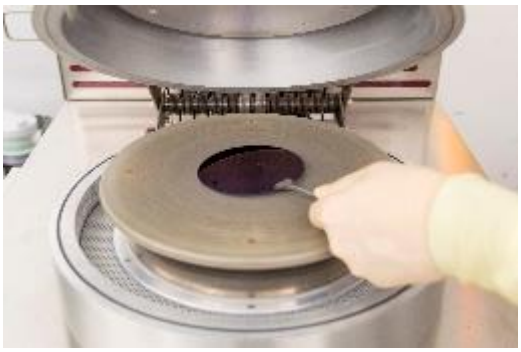
Post AFM cleaning, two steps is usually applied. Silicon free media will be an additional benefit.

CHALLENGE

- Ultimate deburring of hundreds of small holes

BENEFITS

- Get consistent results among all holes of a single plate but also between every parts while driving your labor cost down.
- Forget about eye strain, bring showerhead faceplate to the next quality level, while increase productivity
- Get consistent results among all holes of a single plate but also between every parts while driving your labor cost down



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Gas gate, valves, fittings

Solution for polishing internal channels

A lot components that have simple shapes, become a real challenge when they are used in a high purity environment.

A simple straight gas channel in manifold bloc, a simple 90° fitting, or a simple pipe become a challenge.

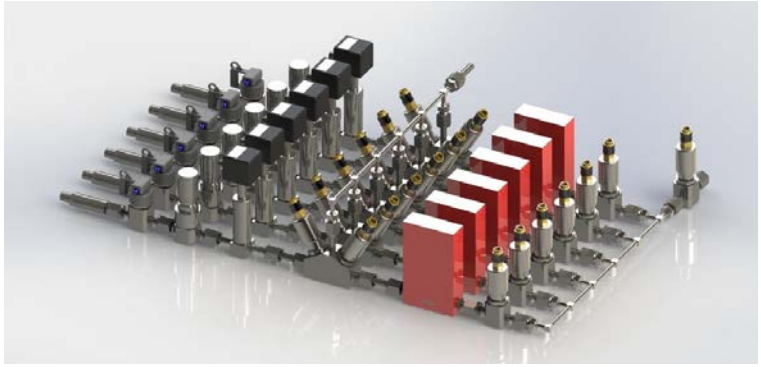
Abrasive Flow Machining is perfectly suited to improve the surface of all these components. AFM will provide mirror like finishes down to 5 µin. Ra.

CHALLENGE

- Finishing of all cross holes
- Polishing of surface

BENEFITS

- 3 minutes cycle time
- Improve stress resistance and cleanliness
- Minimize risk of field failures
- Highest process stability and controllability



Source: GLEW

High purity gas path in 3D printed component

Making 3D printed manifold gas path better.

Processes like Atomic Layer deposition (ALD) or Chemical Layer Deposition (CVD) works with harsh hot gas. The manifolds used in a wafer systems are considered as consumable. For organic channel surface improvement, Abrasive Flow Machining (AFM) is The solution. Channel with up to 20mm diameter and down to 100 µm (MICROFLOW) can be processed.
None or minimum tooling would be required to make possible for the media to flow through the channels. Some connecting point can be 3D built and then removed after Abrasive Flow Machining (AFM).

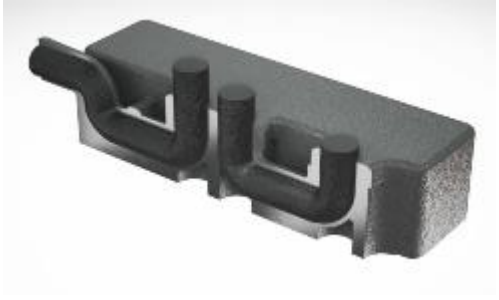
CHALLENGE

- Improve surface in organic channels
- Deal with different diameters
- Remove powder particles trapped in the channel during printing

BENEFITS

- Surface roughness improved up to 20 times
- No particle left
- Clean and polished surface improving the flow

Above: 3D Printed manifolds including organic channels
Below: Cut-away showing rough, contaminated passages



Above: Media flowing through the internal passages
Below: shinny clean internal passages after AFM

Sputtering target

Solution for mirror polishing sputtering target surface the path to the pure material

Sputtering target are used to provide the based material from which atoms will be ejected to be deposited on a substrate like a silicon wafer or a hard drive disk. This high energy bombardment process is taking place in a vacuum chamber filed with inert gas and levering the process of the anode and cathode taking lace at atomic level.

The outcome of the process is a thin film at the surface of the silicon wafer.

Quality of the sputtering target surface is not easy to get. It must be a mirror polished surface with perfect flatness.

It must be a cutting tool marks and scratch free surface. It can not be contaminated by grits or bonding agent. In addition, deformation should be at Zero (deformation means a distortion of the molecules). Usually, conventional machining could not achieve.

Any waste due to issue in sputtering target is costly.

ORBITEX by Extrude Hone is the process of choice to achieved such superior surface requirements with undisturbed layer of molecules.

CHALLENGE

- Mirror polished surface
- Surface with Zero deformation

BENEFITS

- Perfect surface with sub 0.125Ra (5µin.) Ra
- ZERO deformation
- Pure layer of material

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Ceramics gas nozzle

Solution for polishing fine ceramics made nozzle which are used to make electronic components.

Nozzles and injectors are a critical component to ensure precise flow rate and ensure a homogenous spray in to the etch process chamber.

Due to the many constraints that a nozzle should withstand ceramics are the go-to material. They resist high plasma; they have high dielectric strength, and they resist to corrosion environment due to the process gases and byproducts.

One issue with nozzles is gas turbulence from poor surface quality in gas passages.

As a results it becomes broadly necessary to have perfect surface within all the small channels and through the different holes.

Some nozzle can have very intricate design with multiple channels.

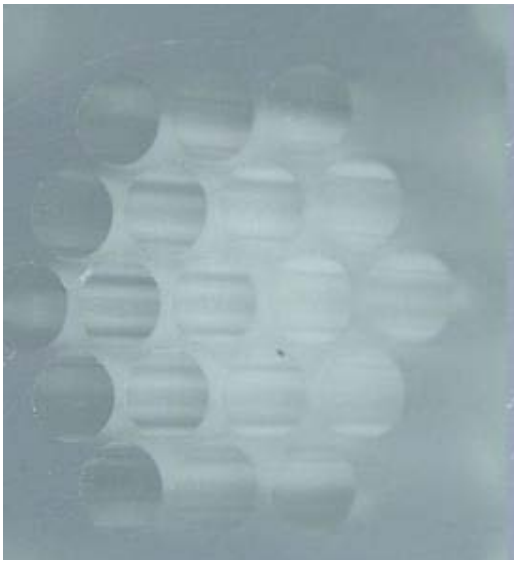
Abrasive Flow Machining is perfectly suited to improve the surface for these nozzle passages. If the holes become too thin for the AFM process, we would switch to MICROFLOW process who can process channels down to 40µm.

CHALLENGE

- Improving surfaces in intricate channels with very small diameters

BENEFITS

- Possibility to process multiple arts at once
- Improved surface roughness reducing gas turbulences



Wafer cutting nozzles

Solution for improving spray quality

Wafer cutting is not that easy due to the fragile nature of the material. Cutting slots, holes or apertures in a wafer can be solved using fine blasting cutting spray.

In this solution, spray shape and spray penetration are key elements of the process, we have the solution to make it better.

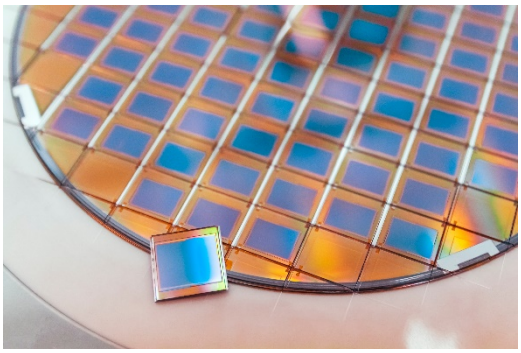
Abrasive Flow Machining is perfectly suited to improve the surface and ensure a radius at the entrance of the spray holes within the nozzle in order to reduce turbulences, improving spray pattern to achieve higher precision.

CHALLENGE

- Superior spray pattern for optimum cutting efficiency

BENEFITS

- Improved nozzle life span
- Better spray pattern with deeper, highly focused penetration.
- Superior cutting efficiency



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Additive in Semiconductor, it‘s now!

When volume or weight is an issue that should be addressed for a given workpiece, Additive design brings solutions that can permit to fit more functions in reduced volume, while saving sometime quite a lot on the weight compared to conventional subtractive manufacturing methods.

While DMLS consolidates its position, the rise of new technologies such as HP Metal Jet is further accelerating the technology’s adoption.

Intricates manifolds, or fancy large support that weight a fraction of what it was, with even more strength are now achievable.

Post-processing, including support removal, surface enhancement, HIP and coating are Industry Hot-Topics due to their significant contribution to AM final quality.

In this scenario, industrial solutions for finishing are becoming a cornerstone to success; this is where Extrude Hone solutions – AFM, ORBITEX, COOLPULSE, and TEM – can deliver an unprecedented advantage to their adopters, with unique quality delivered.

CHALLENGE

- Surface finish requirements for additively manufactured components
- Surface requirement for outer and inner surfaces

BENEFITS

- Removal of partially sintered or bonded material
- Support structure removal
- Improved surface roughness up to 20 times

Equipment or Contract Shop, your choice

Extrude Hone supports customer in the Semiconductor fields in various ways:

Feasibility – Testing

- Test different technologies or a combination to find the perfect solution that suits their needs.

Contract shops

- No need to invest - we have contract shops that can do the job for you. In addition to ISO we also fulfill, depending on the location, various Industry quality standards.

Equipment

- You want to keep the process a secret, we bring machines to your location.
- The full equipment portfolio is for sale. We will support during ramp-up and we will be beside you for service and consumables in the long term.









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