MICROFABRICA®

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MICA Freeform™

MANUFACTURING PROCESS

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MATERIALS DOSSIER

Palladium Manufacturing Processes

Handling

Palladium is non-magnetic and therefore magnetic tools cannot be used to manipulate these parts. Manual handling of small MICA Freeform™ parts made of palladium requires great care and delicacy. Although MFI's Palladium is a relatively hard material (>375 HV), it is still very easy to damage, bend, or scratch such parts when instruments such as stainless steel tweezers are used. Teflon coated or rubber-tipped tools are recommended.

Joining

Laser Welding
It is possible to laser weld both stainless steel and nitinol wires to parts made of palladium.

Palladium tubes with wall thickness of 200ums have been successfully laser welded to nitinol wire using and IR laser as shown in the picture below. The welds have been tested up to 3.3kg of tensile load without failure. As a general rule, the laser welds have been found to perform the best when it can be made along several sections around the circumference of the tube.

Exact laser welding conditions can be optimized for the design, geometry, and desired load rating of each weld.

Machining

Palladium parts created using MICA Freeform™ may be machined. They may be machined in the following stages:

- Stage 1: Fabrication complete, but prior to release etching. At this stage, the palladium part is still encapsulated and held in place by the sacrificial copper material and therefore structurally rigid. The part is typically still on the ceramic wafer at this stage but may also be singulated and separated into die form if needed. Machining at this stage affords the greatest safety and stability to the palladium part.
- Stage 2: Fabrication is complete and the part has undergone release etching, removing the sacrificial copper and allowing it to be freely manipulated and exercised. Machining may also be performed at this stage, but there is an added risk as there is no longer a stabilizing copper matrix to hold the part in place to provide structural support. However, this stage may afford visibility of specific locations and areas that may need special scrutiny or observation during machining that would not be possible if the sacrificial copper was still in place.

Conventional dicing and slicing operations are possible with palladium parts at Stage 1, and potentially possible at stage 2 provided a suitable stabilizing matrix and fixturing is provided. The viability of other operations such as wire EDM is high but yet unconfirmed.

Palladium Manufacturing Processes

Heat Treatment

Palladium parts made by MICA Freeform™ are hard and relatively brittle, and they may be heat treated to reduce their brittleness and enhance their ductility. Temperatures above 400C have been used to dramatically soften the materials and more than double their ductility.

One important note is that an intermediate amount of heat treatment may actually increase the hardness and brittleness of the palladium parts and therefore the proper temperature regimes and time scales must be used during heat treatment.

Storage

Palladium products are stable and have an indefinite shelf life under normal (room temperature) storage conditions. In general, palladium parts are not sensitive to humidity.

Deburring

In general palladium parts manufactured by MICA Freeform™ do not have burrs and do not require deburring operations.

Valloy-120™ Manufacturing Processes

Handling

Valloy-120™ is a ferromagnetic material and therefore a recommended handling method is to use a magnetic tool to manipulate and maneuver the parts. Manual handling of small MICA Freeform™ parts made of Valloy-120™ requires great care and delicacy. Although Microfabrica's Valloy-120™ is a relatively hard material (>350 HV), it is still very easy to damage, bend, or scratch such parts when instruments such as stainless steel tweezers are used. If manual handling is required, then Teflon coated or rubber-tipped tools are recommended.

Joining

Laser Welding

It is possible to laser weld both stainless steel and nitinol wires to parts made of Valloy-120™. Valloy-120™ parts in tubular shape with wall thickness of 100ums have been successfully laser welded to nitinol wire using an IR laser. The welds have been tested up to 6kg of tensile load without failure. The exact laser welding conditions can be optimized for the design, geometry, and desired load rating of each weld. However, as a general rule, the laser welds have been found to perform the best when it can be made along several sections around the circumference of the tube.

Machining

Valloy-120™ parts created using MICA Freeform™ may be machined. They may be machined in the following stages:

- **Stage 1:** Fabrication complete, but prior to release etching. At this stage, the Valloy-120™ part is still encapsulated and held in place by the sacrificial copper material and therefore structurally rigid. The part is typically still on the ceramic wafer at this stage but may also be singulated and separated into die form if needed. Machining at this stage affords the greatest safety and stability to the Valloy-120™ part.
- **Stage 2:** Fabrication is complete and the part has undergone release etching, removing the sacrificial copper and allowing it to be freely manipulated and exercised. Machining may also be performed at this stage, but there is an added risk as there is no longer a stabilizing copper matrix to hold the part in place to provide structural support. However, this stage may afford visibility of specific locations and areas that may need special scrutiny or observation during machining that would not be possible if the sacrificial copper was still in place.

Conventional dicing and slicing operations are possible with Valloy-120™ parts at Stage 1, and potentially possible at stage 2 provided a suitable stabilizing matrix and fixturing is provided. The viability of other operations such as wire EDM is high but yet unconfirmed.

Valloy-120™ Manufacturing Processes

Heat Treatment

Valloy-120™ parts made by MICA Freeform™ are relatively hard and possess sufficient elastic strength to be used as springs and cantilevers. The material properties of the Valloy-120™ may be modified by heat treatment processes. Moderate temperatures of up to 290C do not degrade the spring constant of the Valloy-120™ significantly, although prolonged exposure to heat at this temperature will soften the part. Higher temperature annealing operations can also lower the spring constant and soften the material.

Storage

Valloy-120™ products are stable and have an indefinite shelf life under normal (room temperature) storage conditions. In general, Valloy-120™ parts are not sensitive to humidity.

Deburring

In general Valloy-120™ parts manufactured by MICA Freeform™ do not have burrs and do not require deburring operations.

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