

Brazing with Photochemical-Etched Amorphous Filler Metal Preforms

Examination of the edge condition and its impact on wetting stainless steels, as well as benefits and considerations, are explored

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Brazing filler metal preforms have been used in various industries for many years. Preforms using powders include tapes and presintered powders. Rolled and amorphous braze filler metal sheets can be stamped into preforms or laser cut to size. While each of these offers a different set of advantages, the growth of more customization has led filler metal suppliers to look for alternative ways to add value for their customers. Photochemical etching or photochemical machining was developed in the 1960s as a rapid manufacturing process to quickly design and manufacture complex shapes out of thin sheets (less than 0.06 in.) (Ref. 1). Amorphous brazing foil thicknesses range from 0.00078 to 0.003 in., which make them ideal candidates for utilizing the photochemical etching process to manufacture preforms.

Discussion

One of the major advantages of using amorphous brazing filler metals in a joining process is the ability to preplace the filler metals in only the areas that are required. This gives the designer the versatility of utilizing complex shapes, which are specifically used in heat exchanger applications and allows optimal flow path designed to maximize heat transfer. Another benefit is the ability to automate product assembly while minimizing waste as the total known volume can be tightly controlled with the geometry of the preform.

Nickel-based amorphous brazing filler metal preforms are typically stamped or laser cut to size. While stamping offers a robust process that

can be very cost effective, tooling can be expensive (typically \$5000–\$20,000) and requires regular redressing due to the high hardness of the foils (Ref. 2). Laser cutting does not require tooling; however, there will be some re-cast areas that can impact stackup tolerance and melting characteristics.

Photochemical etching utilizes a photo tool that operates like a stencil by masking the area to remain after the etching process. Ultraviolet (UV) light is used to develop the image, which hardens the area exposed to the UV light. The softer photoresist left behind is washed away, leaving only the exposed metal to be chemically re-

moved. The sheet is then sprayed with a heated acid etchant from both sides to dissolve the unwanted metal. Finally, the photoresist is stripped away and rinsed multiple times to ensure there is no remaining etchant (Ref. 3). Figure 1 shows a schematic depicting the process when etching from one or both sides of the filler metal.

Figure 2 is an example of the intricate shapes that can be developed for amorphous brazing filler metal preforms using the etching process. The small holes at the edge of the samples

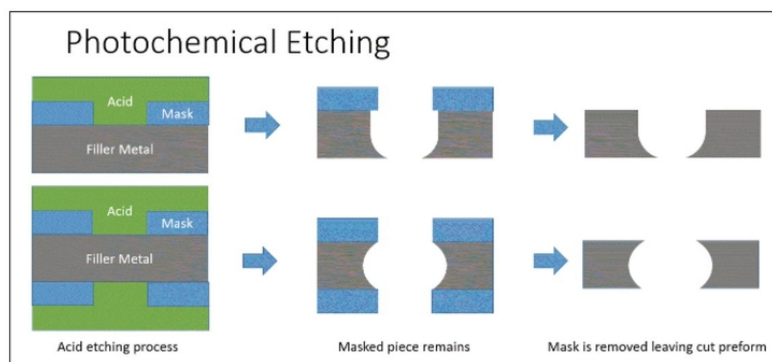


Fig. 1 — Schematic of the etching process from one or both sides of the filler metal.

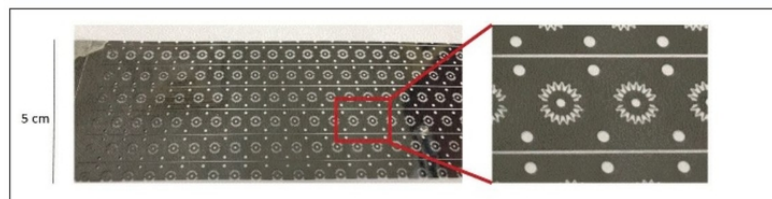


Fig. 2 — Example of a detailed filler metal after the etching process.

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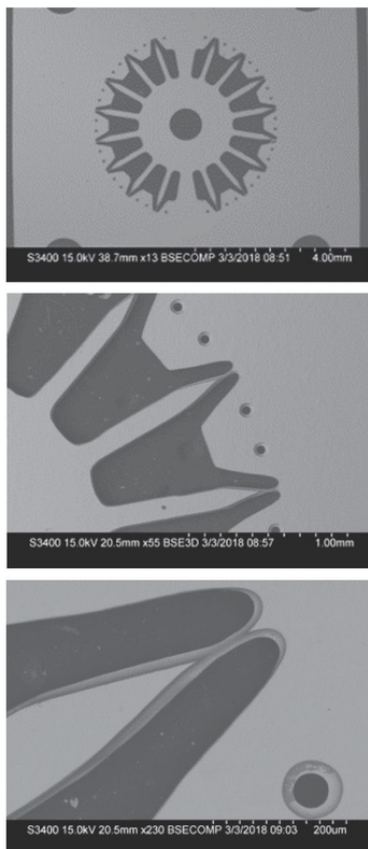


Fig. 3 — Example of complex shapes that can be manufactured using photochemical etching under increasing levels of magnification.

are perforations that are left on the sheet. An automatic process can then remove each preform and place them where required in the assembly.

Scanning electron microscope images of the etched preform are shown in Fig. 3. The higher levels of magnification show that the edge cut is slightly beveled. However, the edge condition of the filler metal preform on this small length scale is rarely significant in the brazing process. General tolerances are $\pm 15\%$ of the base material thickness and a ± 0.001 -in. location tolerance.

Most brazing processes do not require the level of complexity shown in Figs. 2 and 3. Larger shapes are needed more often, such as the image of the preform with a triangular section removed in Fig. 4. This type of braze preform is also ideal for chemical etching, as it provides an alternative to



Fig. 4 — Example of a simple-shaped preform that can be manufactured using photochemical etching.

stamping or laser cutting. In large-volume production of simple preforms, stamping is likely to be more cost effective. Shapes such as circular washers are commonly produced using stamping of the filler metal.

Conclusions

Photochemical-etched amorphous brazing filler metal preforms give manufacturers the option of a process with inexpensive tooling, rapid production timing, and ease of automation. The edge condition of these preforms is consistent, with no impact on stackup tolerance, as there are no burrs or recast layers. This also has no impact on wetting vs. the virgin filler metal because all of the etchant is

washed away, and there is no phase change in the preform. [WJ](#)

Acknowledgments

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