Direct-Solar-To-Hydrogen Prototype Fabrication

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ACT-H2
HYDROGEN RESEARCH

Background

- Final devices result from multiple iterations of a design-fabrication-test process, called prototyping, which requires creativity and adaptability.
- Requirements:
  - Simple design.
  - Resources readily available.
  - Fast turn-around & critical path prioritisation.
- Tools:
  - Design: Fusion 360, Adobe Illustrator, Carbide Create, ProtoMAX Make.
  - Laser Cutting.
  - Abrasive Waterjet Cutting.
  - Computer Numerical Control (CNC) machining.
  - Tungsten Inert Gas welding.

Principles

- Design
  - Limits of machine travel (X,Y, Z).
  - Surface finish of tooling, further steps required to complete the part.
  - Tolerance for fit with other parts.
- Process flow
  - Minimal number of steps.
  - Machining all features in a single operation reduces errors.
  - Alignment procedure optimisation.
- Work-holding
  - Proper reference face and zero point.
  - Stock held securely against the force applied by the machine.
  - Presence of tabs to prevent movement when parts cut through.
  - Use of jig for accurate repeated cuts.
  - Clamp positioned close to the cut but causing no interference.

Acknowledgements

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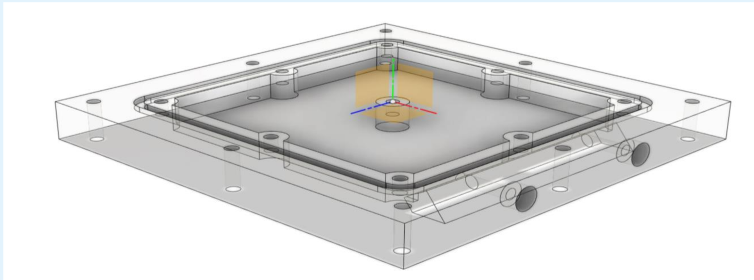
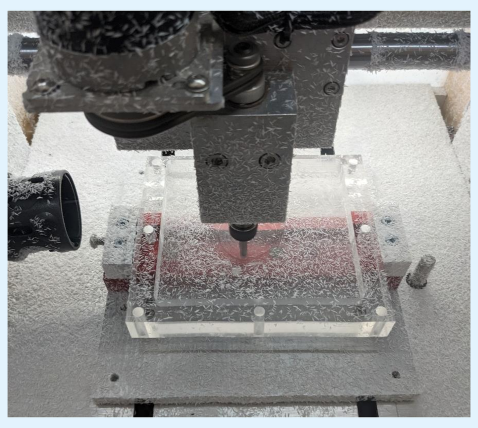
Fabrication processes

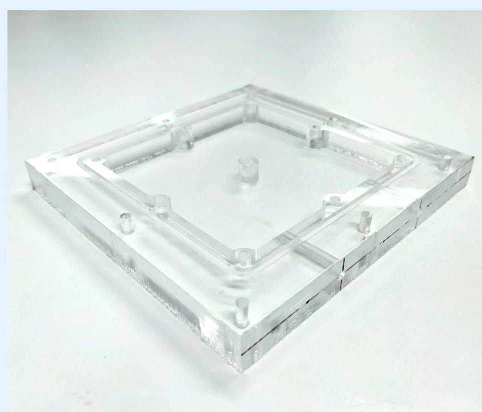
1 CNC Machining



Fusion 360 CAD model of a part. G-code generated by Carbide Create.

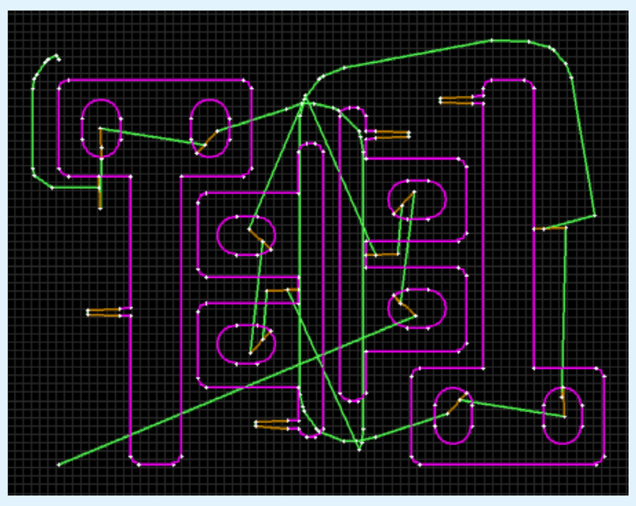


Machining process. 3.12mm endmill at 25000 RPM and 1100mm/minute.

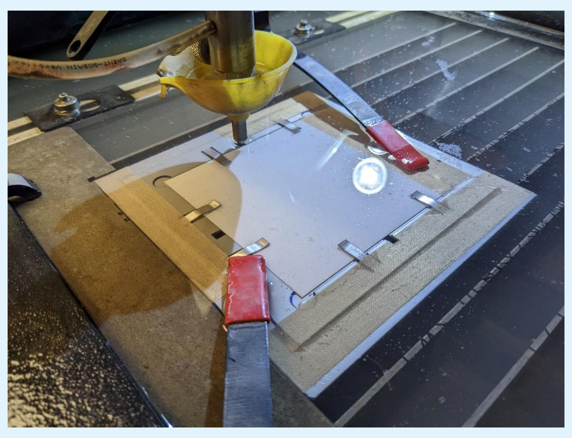


Finished part. Single flute carbide endmill gives excellent surface finish in acrylic.

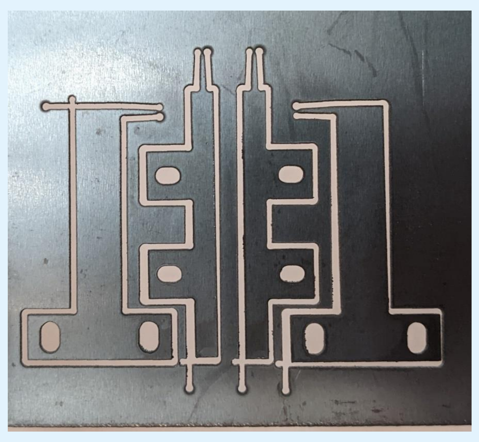
2 Abrasive Waterjet



ProtoMax 2D CAM drawing of parts. dxf file used to generate tool path.

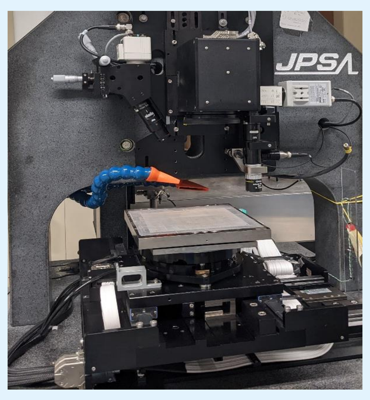


Water-jetting process. Even hard materials such as alumina (shown above) can be cut at low speeds.



Completed cut. Kerf is ~0.7mm permitting 1mm features.

3 Laser Cutting – Fibre and DPSS Laser

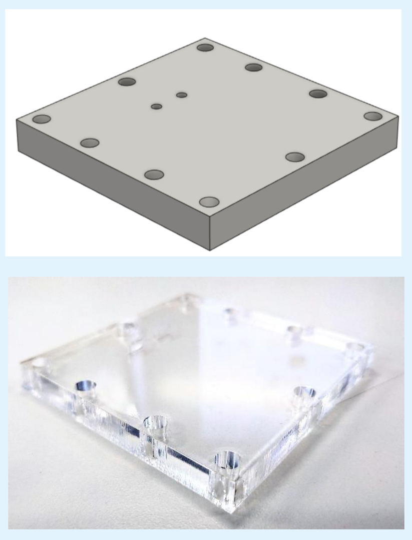


DPSS Laser. A vacuum chuck is used to hold the part

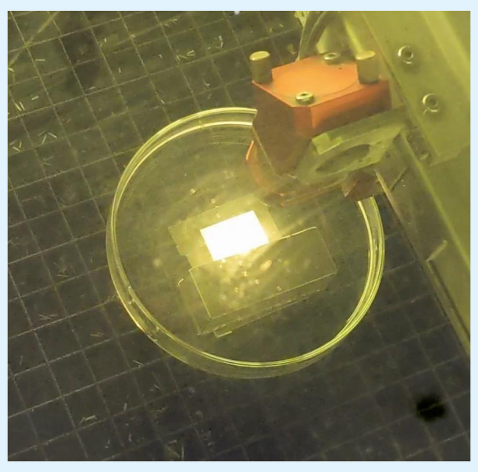
Mask cut from a silicon wafer.

- JPSA pulsed micromachining laser.
- 532nm and 1064nm wavelengths.
- Galvanometer-based etching and multi-pass cutting of silicon.
- 20W fibre laser on the Trotec.

4 Laser Cutting – CO_2 Laser



CAD model of part (top) and laser cut part (bottom). No additional finishing steps needed.



Cutting alumina under water. The water absorbs heat and prevents cracking.

- Trotec Speedy 360.
- 65W CO_2 laser, broad range of material processing capability.
- Fast and accurate acrylic cutting up to 20mm thick.
- Alumina machining underwater.

Further Information

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