Laser Processing of 3M™ Thermally Conductive Acrylic Interface Pad 5550H

- Smooth laser-processed edges and minimal heat-affected zones
- No degradation to the physical properties of the materials
- Eliminates material deformation during processing
- Consistently and repeatedly process 3M pad 5550H to a high degree of dimensional accuracy

PROCESSING EXAMPLE

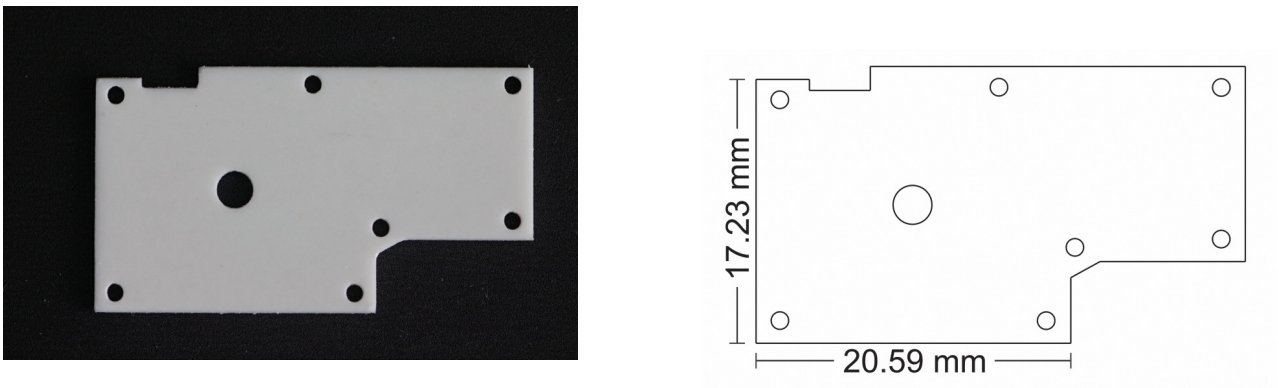

Figure 1. *Example of the fine geometry possible with laser processing 3M pad 5550H.*

3M Thermally Conductive Acrylic Interface Pad applications requiring fine geometry and intricate detail without degrading the physical properties of the material can be achieved with Universal Laser Systems technology. An example demonstrating the results of laser processing the 3M pad 5550H material is shown in ***Figure 1***.

MATERIAL OVERVIEW

3M Thermally Conductive Acrylic Interface Pad 5550H is one of 3M's Conductive Pressure-Sensitive Adhesives (CPSAs) similar to 5570, 5571, 5578, 5589, and 5590. 3M pad 5550H is a highly conformable and ultra-soft pad with high thermal conductivity. This pad consists of a slightly tacky acrylic elastomeric sheet filled with thermally conductive ceramic particles. It is designed to transfer heat from heat-generating components to heat sinks and cooling devices, improving device reliability and extending the component's life. The ultra-soft pad conforms to uneven substrates, providing excellent wettability to fill gaps for improved thermal performance. 3M pad 5550H consists of two thermally conductive and conformable layers, available in thickness options of 0.5mm and 1.0mm, and is protected with PET release liners on both the top and bottom surfaces or the bottom surface alone. A diagram depicting the layers of the 5550H material with a bottom PET liner is shown in ***Figure 2***.

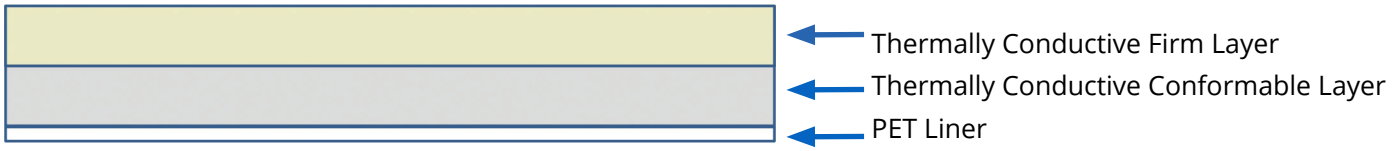

Figure 2. *3M pad 5550H diagram showing PET liners located on the bottom of the thermally conductive acrylate adhesive layers. The product is available in thicknesses of 0.5mm and 1.0mm.*

3M Electrically Thermally Conductive Acrylic Interface Pads are delicate in nature, making them difficult to process with possible deformation when processed with traditional mechanical methods. The non-contact nature of laser processing overcomes this difficulty, which enables the processing of applications with fine geometry and intricate detail. Universal Laser Systems makes it simple to consistently and repeatedly process these materials.

LASER PROCESSING NOTES

3M pad 5550H, specifically 5550H-10, was tested to assess laser processing compatibility and determine the best system configuration of laser peak power and wavelength. The PET liners absorb 9.3µm energy more efficiently than other wavelengths, meaning less peak power was necessary to produce good results with minimum heat effects. Microscopy images taken at 69X magnification of the processed edge of the 3M pad 5550H post-processing are shown in ***Figure 3***. In this image, it is shown that the processed ceramic-filled acrylic pad is relatively free of heat effects and discoloration.

Figure 3. *Microscopy image (69X) of the 9.3µm laser-processed edge of 3M pad 5550H. The ceramic-filled acrylic pad is visually free from heat effects.*

Further inspection of the laser-processed material shows that the acrylate adhesive layer is cleanly processed along the processed path with the 75 watt 9.3µm CO_2 laser source. ***Figure 3*** depicts a microscopy image of the processed surface and the resulting heat-affected zone.

ALTERNATIVE SYSTEM CONFIGURATION ANALYSIS

3M pad 5550H was also tested with an alternate system configuration of 10.6µm laser energy at equivalent laser power level for comparison and determination of the effectiveness of each system configuration. The results of these tests were compared by analyzing the heat effects, quality of the processed edge, and post-processing requirements. The results of the comparison of these system configurations are listed in tabular form in ***Table 1*** and ***Figures 4***. Both system configurations appear viable with some reduction in quality of the results for the 10.6µm configuration as stated in the comparison.

Table 1. System Configuration Comparison

System Configuration	Heat-Affected Zone	Process Characteristics	Post-Processing Requirements
9.3µm (strongly recommended)	Processed edge relatively free of heat effects.	The 9.3µm laser energy has the advantage of better absorption by the material resulting in a consistent edge along the processed path.	Processing of the 3M pad 5550H material with either the 9.3µm or the 10.6µm configuration did not require additional post-processing.
10.6µm	Increased heat-affected zone compared to 9.3µm wavelength of approximately 77µm.	This configuration results in an increased heat-affected zone along the processed path when compared to the 9.3µm configuration.	

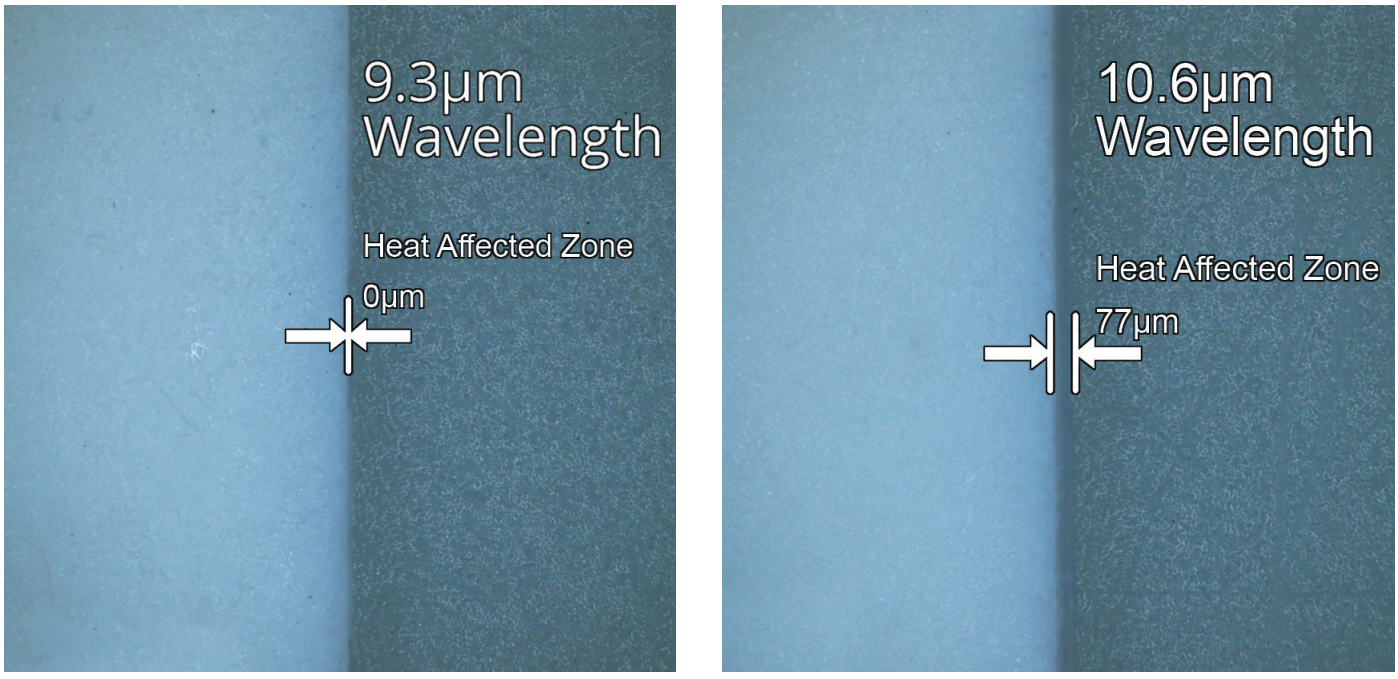

Figure 4. *Comparison microscopy images (69X) of the processed edge resulting from 9.3µm processing (left), and 10.6 µm processing (right). The PET liner was left in place for both samples.*

CONCLUSION

3M pad 5550H is very well suited for laser processing and was extensively tested to determine the most efficient processing configuration. Through this testing, it was determined that laser processing is viable with this material, and a 75 watt 9.3µm CO_2 laser source is the best configuration of wavelength and power for the processing of this material. The thermally conductive ceramic-filled acrylate pad and PET liner and acrylate adhesive layer efficiently absorb the 9.3µm wavelength laser energy and, coupled with the peak power of the 75 watt laser source, produce a clean smooth processed edge that has minimal heat-affected zone and discoloration.

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