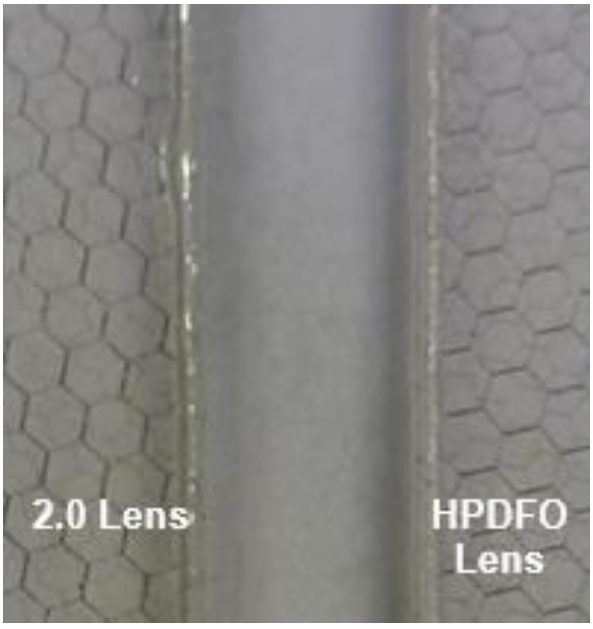
Understanding the Multiwave Hybrid™ Processing of PET

Material Description

Polyethylene Terephthalate (PET) is a colorless thermoplastic. It is semi-rigid and lightweight. It has excellent vapor and moisture barrier properties. About 60% of the world's PET production is for synthetic fibers. In textile applications, the common name "polyester" is used. About 30% of production is for beverage containers and other packaging applications. In packaging applications the acronym "PET" is used. Because of its high transparency PET is also used as a substrate layer in touch screen applications.

Laser Processing Observations

PET can be easily cut with a CO_2 laser. To the naked eye, the cut edge appears smooth. However microscopic examination reveals edge defects when the 2.0 lens is used. Switching to the HPDFO eliminates these defects (see image below). The test vehicle here is a flexible touch screen element based on a PET substrate. The results suggests a more sharply focused beam reduces the HAZ and effectively eliminates the edge defects. Simply increasing the laser power did not achieve the same effect.



It is well known that a 9.3 µm CO_2 laser creates a more legible mark on PET than a 10.6 µm laser. This is illustrated in the image below:

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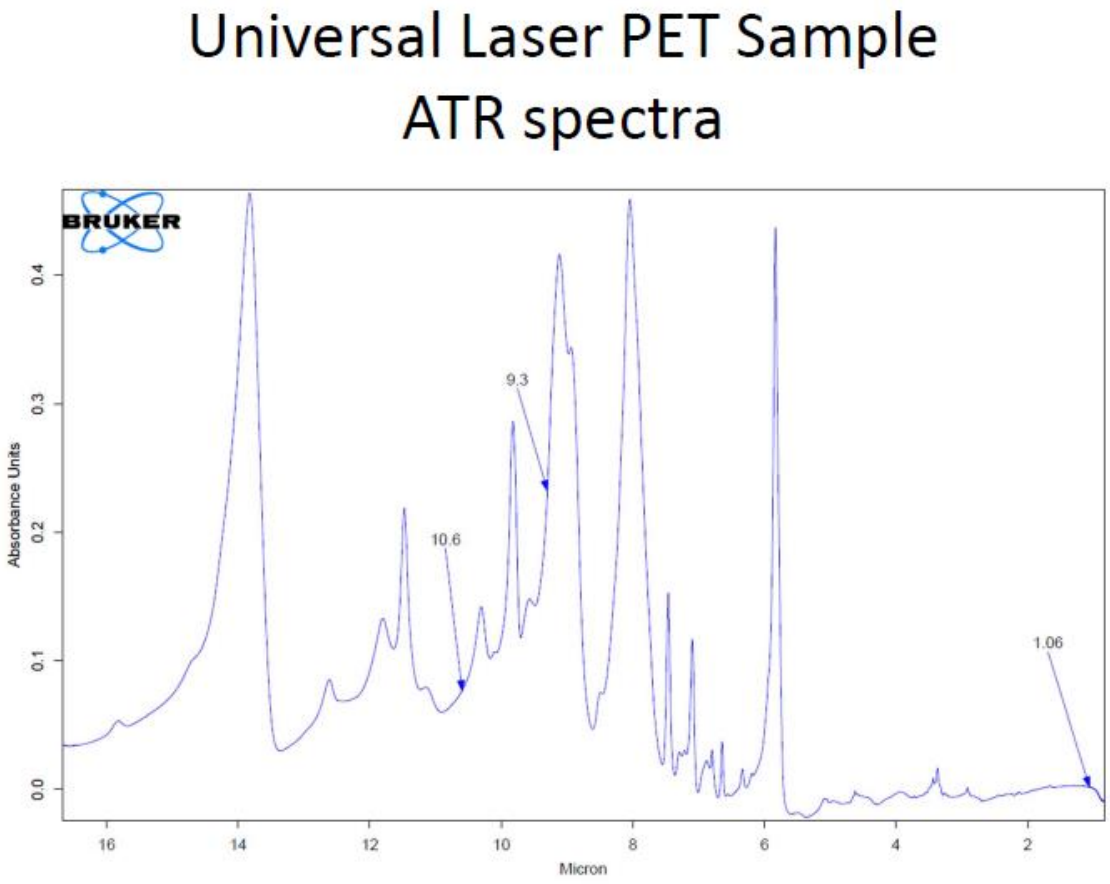
The most likely reason for the improved marking quality is the increased absorbance at 9.3 μm versus 10.6 μm as indicated in the spectrum below:



Hypotheses Regarding Multiwave Hybrid Processing of PET

PET decomposes cleanly, giving off gaseous byproducts like CO_2 and CO as well as volatile organic byproducts like ethylene and benzene [1, 2 &3]. The difficulty in laser cutting PET is the microscopic edge defects that are noted above. However we have already shown that these defects can be eliminated by using a high power density, such as with the HPDFO. The HPDFO is essential built into our Multiwave Hybrid optics so cutting PET on the XLS10MWH using the 2.0 lens should work without further process modification.

Testing our Hypotheses for Multiwave Hybrid Processing

The hypothesis stated above will be easy to verify. We should simply cut a piece of 0.005″ PET on a PLS or ILS with the HPDFO. Then do a microscopic examination of the edge to ensure that the cut quality documented above has been achieved. Then transfer

that process to a XLS10MWH with a 2.0 lens. Finally, perform a microscopic comparison to ensure that the cut quality is equivalent or better.

References

1. S. Venkatachalam, S. Nakyak, J. Labde, P. Gharal, K. Rao and A. Labde, "Degradation and Recyclability of Poly (Ethylene Terephthalate)", Materials Science, Chapter 4 (2012).
2. K. Sovova, M. Rerus, I. Matulkova, P. Spanil, K. Druahina, O. Dvooak and S. Civis, "A study of Thermal Decomposition and Combustion Products of Disposable Polyethylene Terephthalate", Molecular Physics, vol. 106, Issue 9-10 (2007).
3. I. Ferguson, "Analysis of Laser Processed PET", ULS Internal Report.