

# Development of a Duct Tape FTIR Library for Forensic Analysis

Gilbert Vial, M.S., Liang Zhao, Ph.D., Sudhir Dahal, Ph.D., Rachel Lieberman, Ph.D.

## Introduction

Duct tape is a common household product that can often be found at crime scenes. Duct tape can be used in crime scenes pertaining to homicide, robbery, kidnapping, breaking and entering. Duct tape is made of multiple layers; a backing, fabric to reinforce strength and an adhesive layer. Different manufacturers use different types of backing or fabric reinforcement for different applications of duct tape. The ability to be able to identify a brand or type of duct tape can prove to be useful for investigators. FTIR is an incredibly versatile and useful technique for forensic investigation and will ultimately aid in crime investigations

Because duct tape is made of at least three different layers, the middle layer, the fabric reinforcement, is the most protected from external contamination; while the inner and outer layers are more likely to come in contact with materials external to the duct tape. Three-layer duct tape could be viewed as 'normal' strength duct tape; while, heavy duty duct tape could include more than three layers and/or more complex fabric reinforcement.

## Experimental

Duct tape samples were prepared using forceps to separate the backing, fabric and adhesive layers. 5 different duct tape types were selected:

1. 3M 2979 Duct Tape
2. 3M 2910 Duct Tape
3. Duck Tape Duct Tape
4. CVS Store Brand Duct Tape
5. Ace Hardware Brand Duct Tape

Each type of duct tape was selected as it consists of three layers, one backing, one fabric reinforcement layer and one adhesive layer to maintain consistency. Duct tape samples were ripped from the roll to be consistent with real world samples. Reflectance infrared spectra of the samples were collected using Shimadzu AIM-9000 FTIR microscope.

## Data

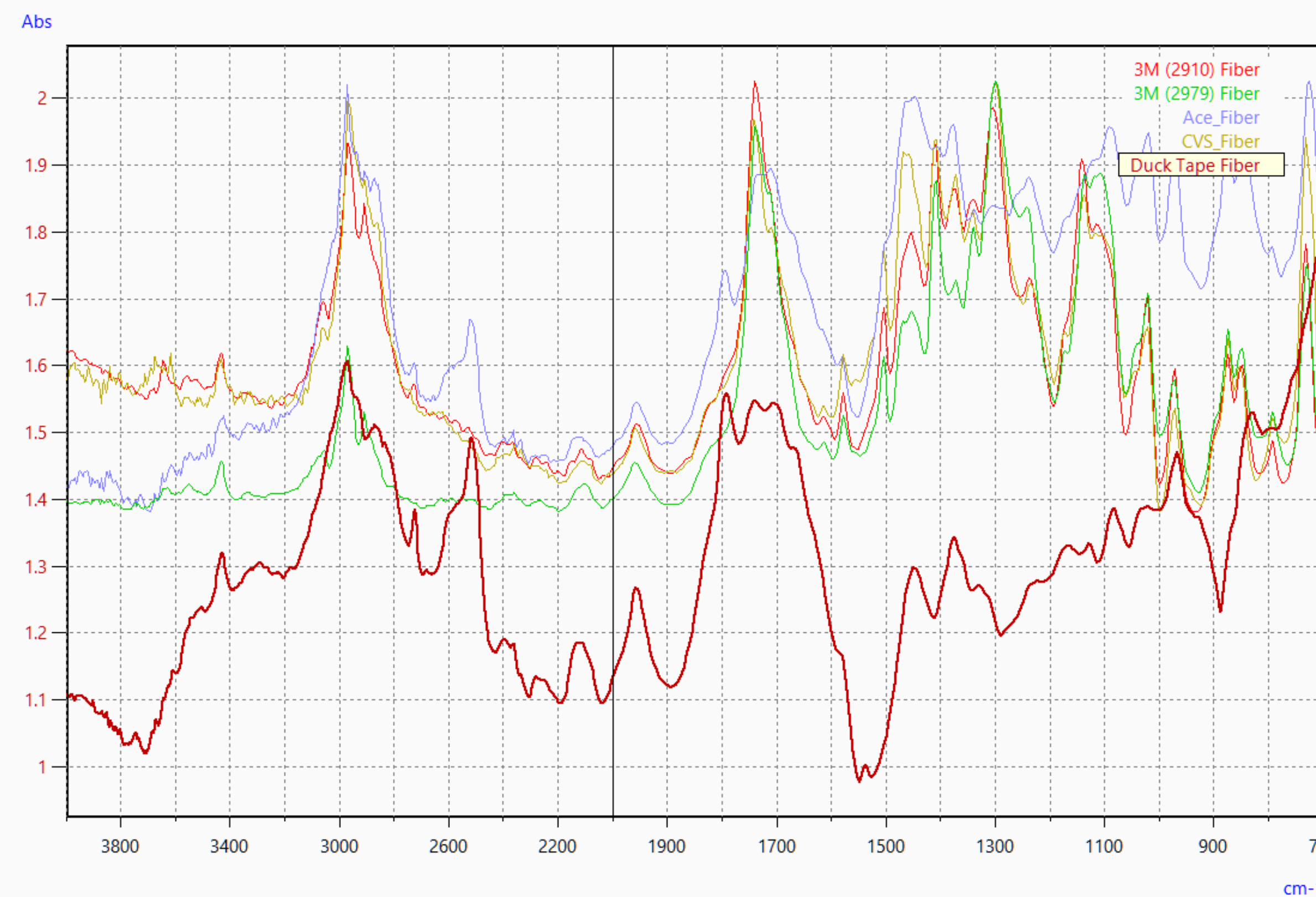


Fig. 1 – Overlaid infrared spectra from five different duct tapes, fabric reinforcement layer.

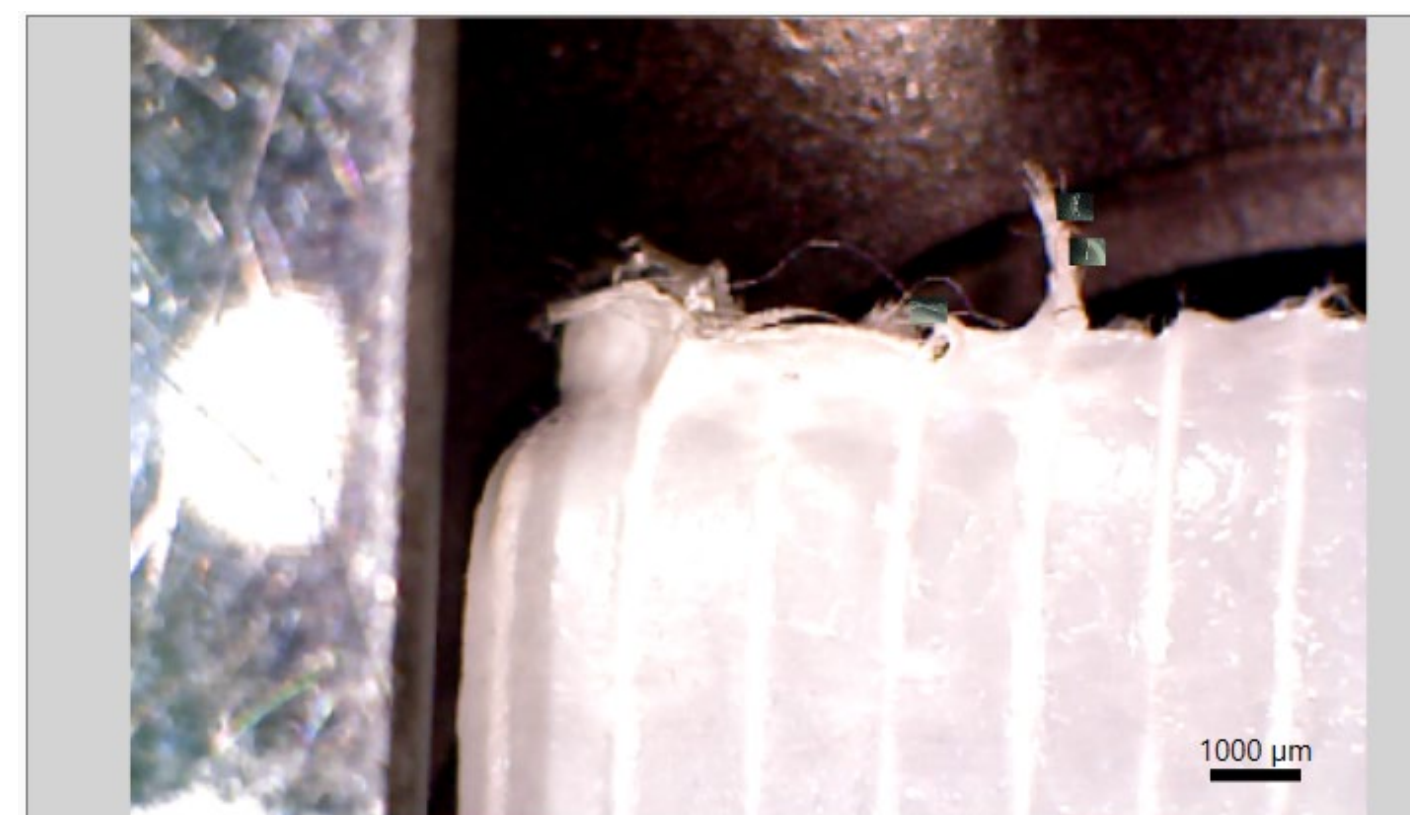


Image 1 – Visual image from AIM-9000 microscope for CVS duct tape.

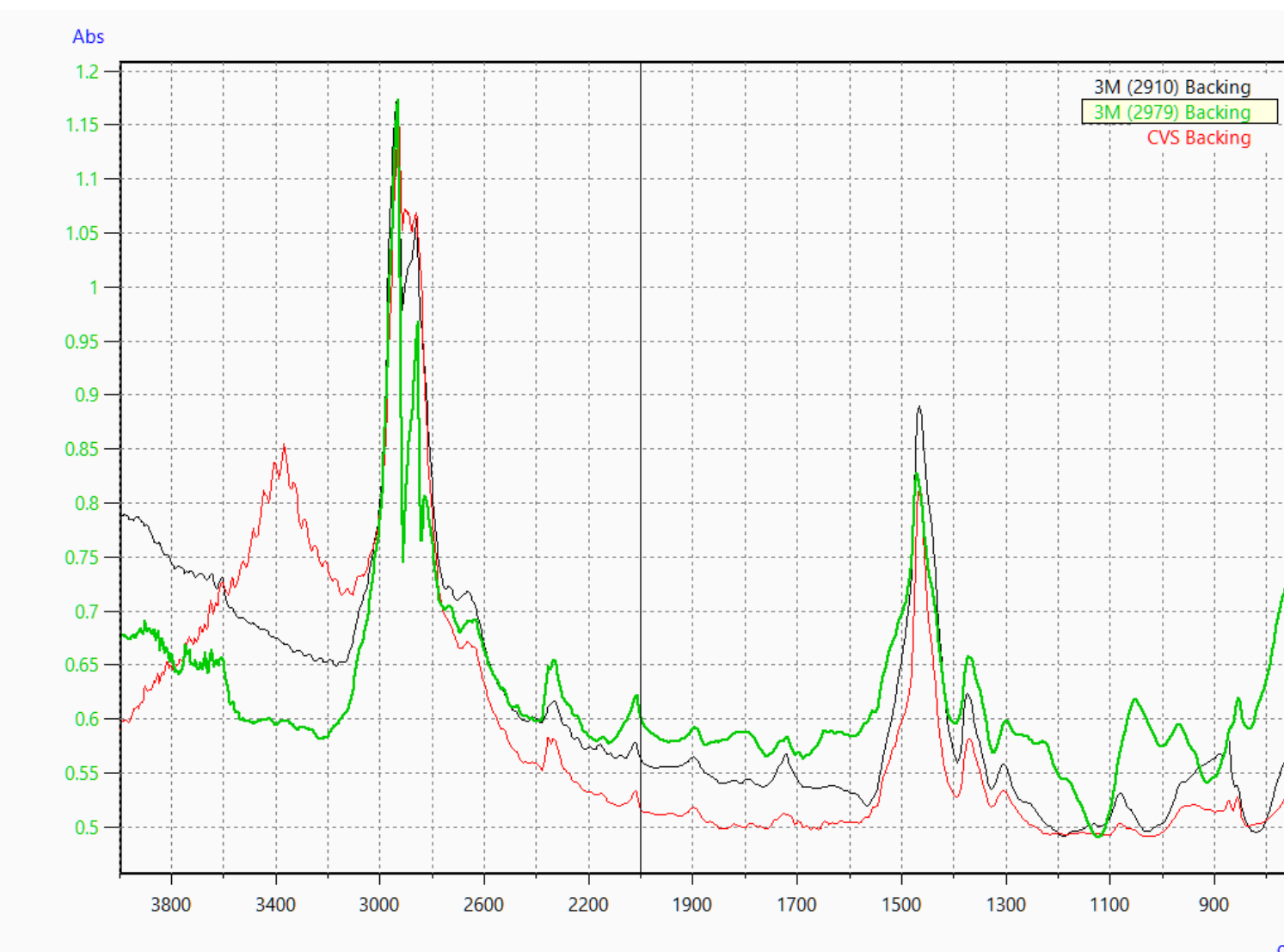


Figure 2 – Comparison overlay between CVS brand, 3M (2979) and 3M (2910) brand duct tapes

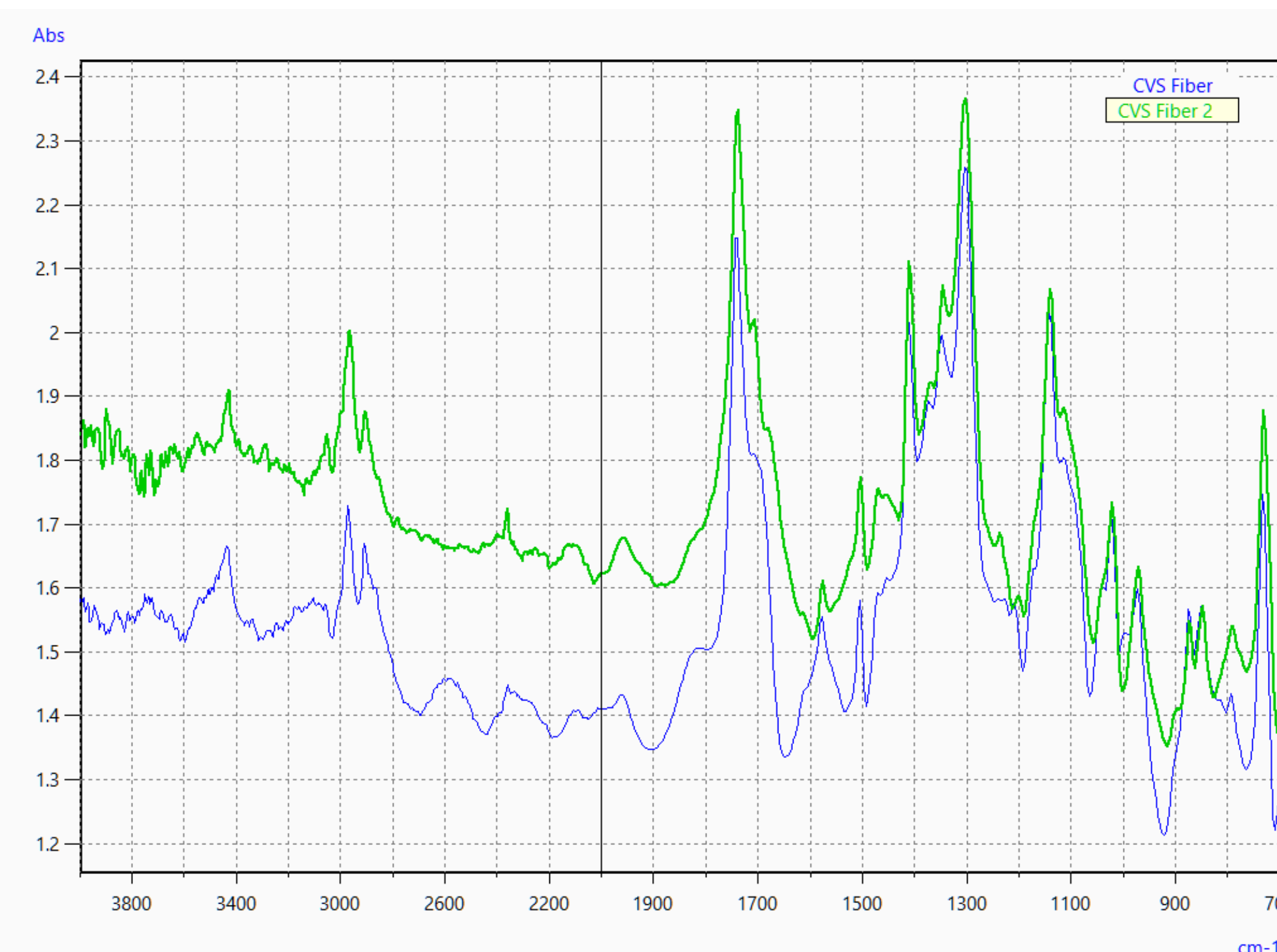


Figure 3 – Comparison overlay between two samples of CVS duct tape.



Image 2 – CVS Fiber (Fig. 3) measurement image.

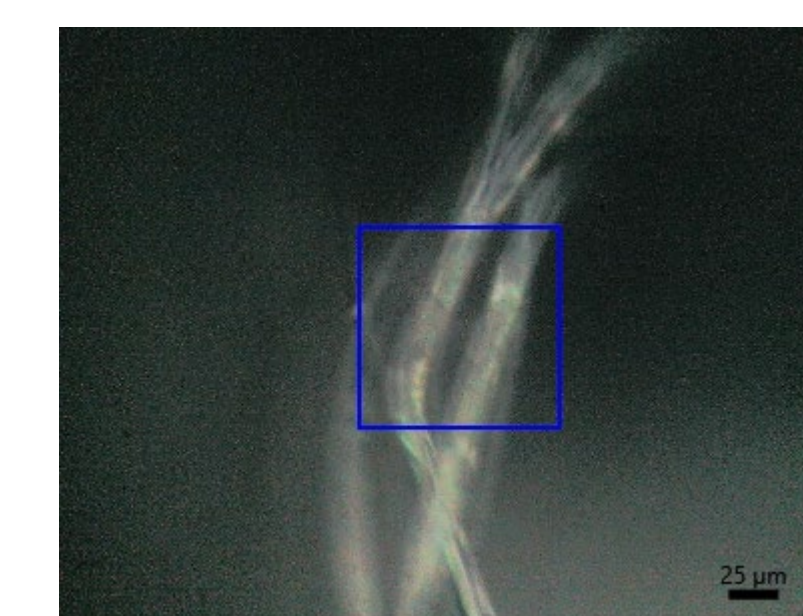


Image 3 – CVS Fiber 2 (Fig. 3) measurement image.

## Results

Similarities were observed between different brand duct tapes at different portions, for example, the backing between the 3M tapes were similar to the CVS brand tape and the fibers had similarities between all brands. All 5 brands of duct tape gave library search results close to polyester, a common material for the fabric reinforcement layer. The backing material also provided a library match of low-density polyethylene (LDPE) which is consistent between the different duct tape samples as well.

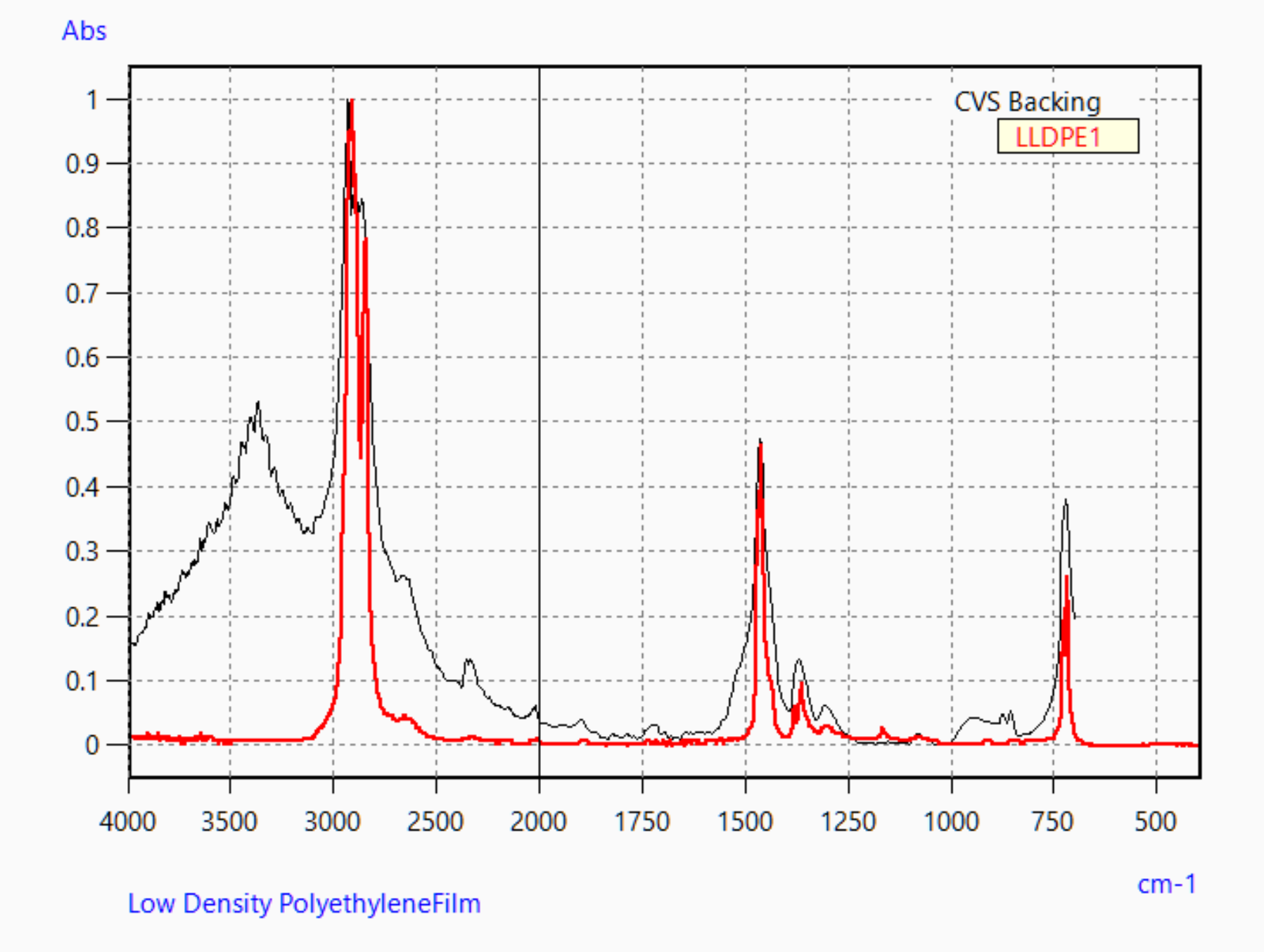


Figure 4 – Library search comparison of backing material (CVS Tape)

## Discussion

The preliminary results of the study have shown that it is possible to create a library of various duct tapes and their respective layers. The main obstacle comes from requiring the real-world samples to allow for investigators to recover usable samples for comparison. The five types of selected duct tape have shown consistency between known duct tape materials.

## Conclusion

Combining FTIR results from the backing, fabric and adhesive layers could allow for a proper identification of duct tape brand. The ability to identify duct tape could prove to be an incredibly useful tool to aid investigators. Future work will expand the number of duct tape brands.