

# AN FT-IR STUDY OF PRESSURE-INDUCED SPECTROSCOPIC CHANGES IN A PRESSURE-SENSITIVE ADHESIVE

## INTRODUCTION

Pressure-sensitive adhesives (PSAs) are self-adhesive materials designed to stick on contact to nearly any surface. First introduced around 1925, the PSA market has expanded from masking tape to include labels, tapes and temporary protective covers for a variety of surfaces. Since PSAs do not rely on solvent evaporation or mixing of chemicals for operation, they are considered safer and more reliable to use in non-structural applications. This, combined with their ease of use, makes PSAs an increasingly attractive alternative to more traditional adhesives.

As the applications of PSAs expand, it becomes increasingly important to understand the chemistry that allows them to function effectively. A better understanding of PSA chemistry can be used to assist in fine-tuning the PSAs for specific applications and also in troubleshooting manufacturing problems.

PSAs are multiphase systems whose adhesive properties are directly related to their chemical architecture. It has been shown that there are visibly observable cavitation effects upon the release of some PSAs. These cavitation effects are thought to

be due to the movement of the mobile phases of the PSA. If this is indeed the case, there should be corresponding, observable chemical changes.

This applications note explores the use of FTIR-ATR spectroscopy to study pressure-induced chemical changes in PSAs.

## EXPERIMENTAL

A dual-system reactive hot-melt PSA was examined using the VideoMeridian™ diamond ATR accessory (Figure 1) in an FT-IR spectrometer. All spectra were collected with 32 scans at 4  $\text{cm}^{-1}$  resolution using a DTGS detector.

A background single beam spectrum was collected using the clean ATR crystal. Then the sample was placed with its adhesive side against the sampling surface of the diamond ATR crystal. The pressure applicator was lowered onto the sample until it just wet against the crystal, as observed with the video imaging system (Figure 2). A spectrum was collected at this contact pressure and then every 2 force units thereafter, as measured on the VideoMeridian™ display, until few additional spectral changes were observed. For reference, a spectrum was also collected



Figure 1. The VideoMeridian™.

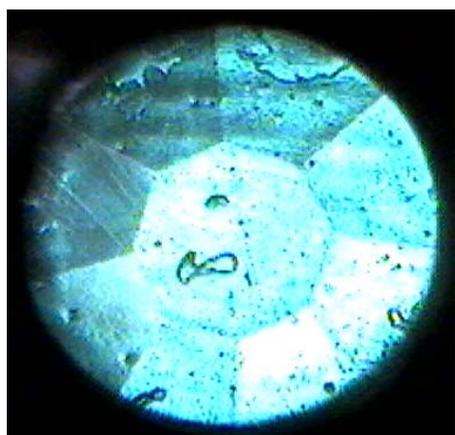


Figure 2. The PSA pressed lightly against the hemispherical ATR crystal. Note: The octagonal central area is the area sampled by the VideoMeridian™.

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from the reverse side of the sample.

## RESULTS AND DISCUSSION

The results are presented in Figures 3A through E, where different spectral regions are shown separately. The spectrum shown in red is from the back side of the sample. The spectrum shown in black was recorded at the lowest contact pressure and the highest contact pressure is shown in dark blue.

From the spectra, it is clear that it is possible to obtain a spectrum of just the adhesive surface of the PSA when very little pressure is applied.

As the contact pressure increases, some spectra features become more prominent. In particular, the C-O region shows an increase in the  $1712\text{ cm}^{-1}$  band and a decrease in the band at  $1732\text{ cm}^{-1}$  with increasing pressure. This indicates that the more mobile esters are moving away from the sampled area, and proportionately more of the less mobile esters are detected.

There are a few bands, specifically those at  $1388\text{ cm}^{-1}$  and  $1470\text{ cm}^{-1}$ , which show no appreciable change in intensity with increasing contact pressure. These bands reflect immobile components of the PSA that are present both in the adhesive surface and bulk material.

## SUMMARY

As seen above, PSAs can be readily examined using the VideoMeridian™. The surface of the PSA can easily be distinguished from that of the bulk by applying very little contact pressure between the sample and the ATR crystal of the VideoMeridian™, making this a quick and convenient method of analysis. In addition, the effect of increasing contact pressure on the mobile phases of the PSA can be investigated.

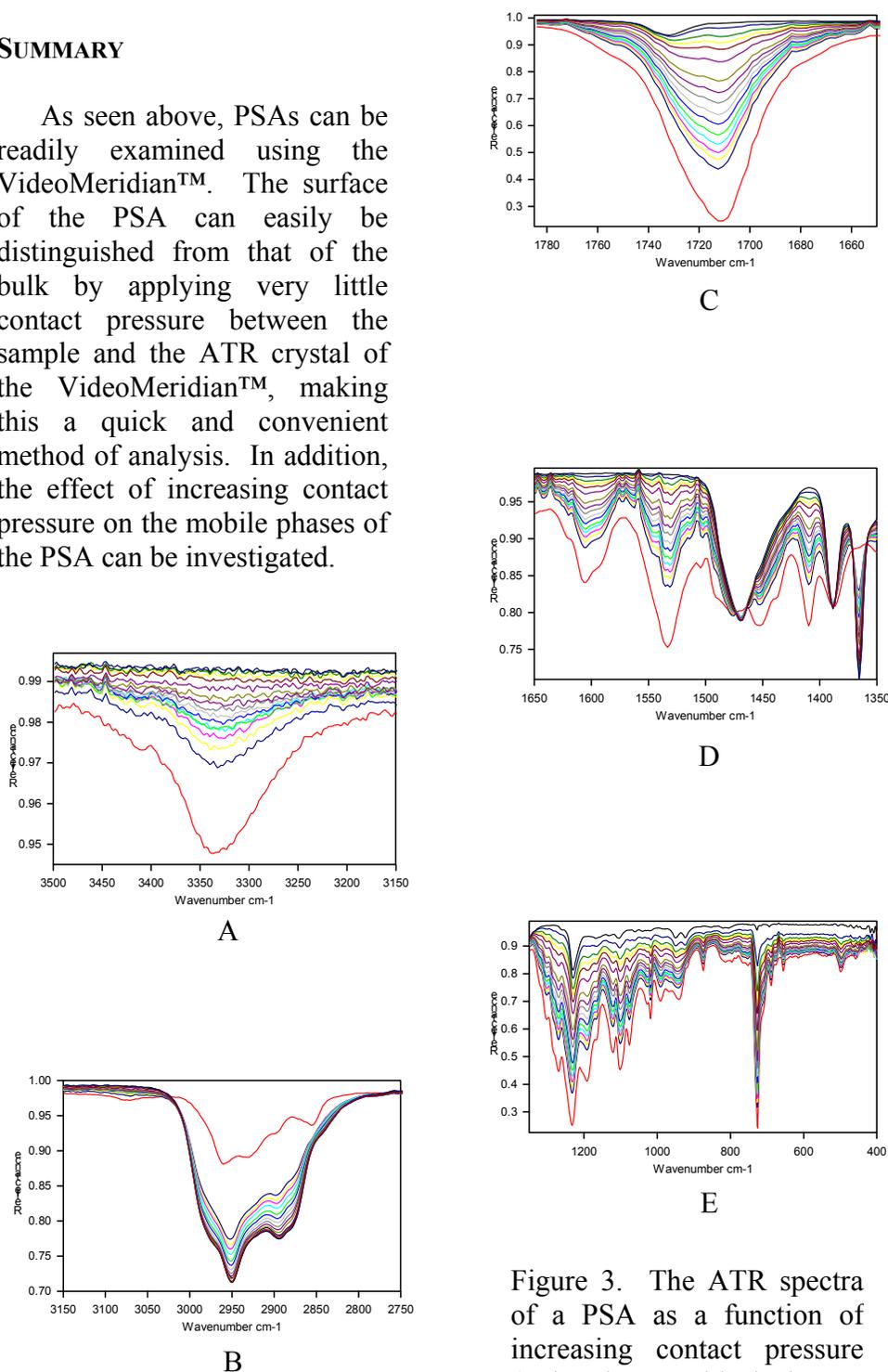


Figure 3. The ATR spectra of a PSA as a function of increasing contact pressure (red: substrate; black: lowest contact pressure; dark blue: highest contact pressure).



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