

focus on Microscopy & Microtechniques

A Novel Tape Lifting System for the Retrieval of Trace Evidence From Crime Scenes

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Adhesive-coated transparent tapes have long been used as the tool of choice when recovering trace evidence from a variety of surfaces [1-3]. These tapes have a number of key advantages. These include their ability to readily isolate evidentially valuable materials from the substrate on which they are found and the fact that these materials can be easily secured by adhering the tape to a suitable backing, such as an acetate sheet. The transparency of these tapes also means that low-power microscopy can be used to search for trace items that may be adhered to them [4]. Such items have the potential to provide evidence of contact between the perpetrator and/or victim of a crime and the surface from which such items have been recovered.

The use of tapes to recover trace evidence is frequently referred to as tape lifting and the tapes once used for this purpose and secured to a backing are known as tape lifts.

Conventional tape lifts have the disadvantage that they are birefringent, making them incompatible with polarising light microscopy (PLM). Also, items recovered on tape lifts are typically surrounded by minute air bubbles, making the microscopic characterisation of their morphological features problematic. The current solution to these problems is to remove the items of potential value prior to their full characterisation. For example, it is common practice to dissect tape lifts to isolate fibres of evidential interest and then mount these on glass slides prior to examination using PLM. This is a very time-consuming [5] and, consequently, expensive process and one which increases the opportunities for evidence loss and contamination.

The authors have therefore devised a new tape lifting system that is effectively non-birefringent and which embeds the trace evidence items that it contains in a medium of suitable optical properties. These features mean that the items of evidence on the new tape lift (known as Easylift) can be characterised *in situ* by PLM, microspectrophotometry and Raman microscopy. If needs be, these items can be readily removed from the new system for further characterisation. We expect that Easylift will be compatible with DNA profiling and sequencing, but this has yet to be verified empirically.

New Tape Lifting Method

In its current form, Easylift has two parts. One of these is for use at the crime scene or when searching garments or other objects in the laboratory. It consists of an adhesive tape attached to a backing film. The tape is similar in appearance to that used for conventional tape lifting. In use, this new tape is removed from its backing, an operation that is easy to accomplish whilst wearing nitrile gloves (Figure 1), and then applied to the surface to be sampled (Figure 2). It is then removed from this surface, after repeat application if desired, and re-adhered to the backing material. There is no need to take care to eliminate bubbles during this process. It is then packaged and sent for analysis.



Figure 1. Easylift tape being removed from its paper backing.

Figure 2. The application of Easylift tape to a surface to be sampled.

The second part is for use in the laboratory. It is a glass slide that is pre-coated on one side. This coating is protected with a backing film (Figure 3). In use, the backing films are removed from both parts of the new system and the tape, together with the items of evidence adhered to it, is placed onto the slide, such that the adhesive on the tape is in contact with the coating on the slide. The two parts of the system are now sealed together by means of low temperature heated rollers. This removes air bubbles, trapping evidence within a transparent environment (Figure 4).



Figure 3. The Easylift coated slide. This image shows the slide viewed from the uncoated side, with the protective paper backing film on the underside of the transparent coating material.

Figure 4. The complete, sealed, Easylift system, with trace evidence trapped within.

This evidence can now be characterised by the methods listed previously. If needs be, items of evidence may be retrieved from the new tape lift system by passing it through the rollers and removing the tape from the slide whilst it is still warm. Alternatively, items can be readily removed from the tape before it is placed onto the coated slide.

This system is quick and easy to use and, other than the rollers, does not require the use of any specialised equipment. Also, in contrast to many traditional slide-making methods, the preparation of slides with this system does not require the use of harmful solvents. Furthermore, this system will be compatible with modern data capture systems that allow images of entire microscope slides to be generated, offering the prospect of semi-automated or fully automated fibre characterisation.

Testing of the New Method

Easylift has been trialled by Staffordshire Police at volume crime scenes, such as burglaries and car thefts. It has been used to recover trace materials from areas of interest, including car seats, seat belts and window frames from points of entry. Feedback was gathered from the Scenes of Crime Officers (SOCOs) regarding ease of use, ability to retrieve evidence and use at the crime scene. A selection of comments from the SOCOs is shown in Figure 5. Forensic practitioners who analyse fibres and other particulates in casework also reviewed Easylift. Practitioners from the UK, the Netherlands, Germany and Australia provided feedback regarding use of the new method in the laboratory, applicability of new method for different evidence types and effectiveness of reducing analysis time. Comments are shown in Figure 6.

In order to ascertain whether the new tape system had an effect upon the microscopical analysis of textile fibres (the most common particulate trace evidence retrieved from crime scenes) compared to the traditional method of placing the fibres in a suitable mountant (in this case Depex), a range of manmade and natural fibres, held in the Easylift system, were examined by PLM with a tilting compensator attachment. Cross sectional shape, width, colour, optical path difference (OPD), birefringence (calculated by $OPD / (\text{thickness} \times 1000)$), surface features and inclusions were observed for each fibre. In order to identify the affect of normal tape on the analysis of fibres evidence, the fibres were also analysed held in J-Lar tape on an acetate backing (J-Lar is a popular tape to use for the retrieval of evidence at crime scenes). Results showed that the new system performed as well as analysing the fibre in a mountant.

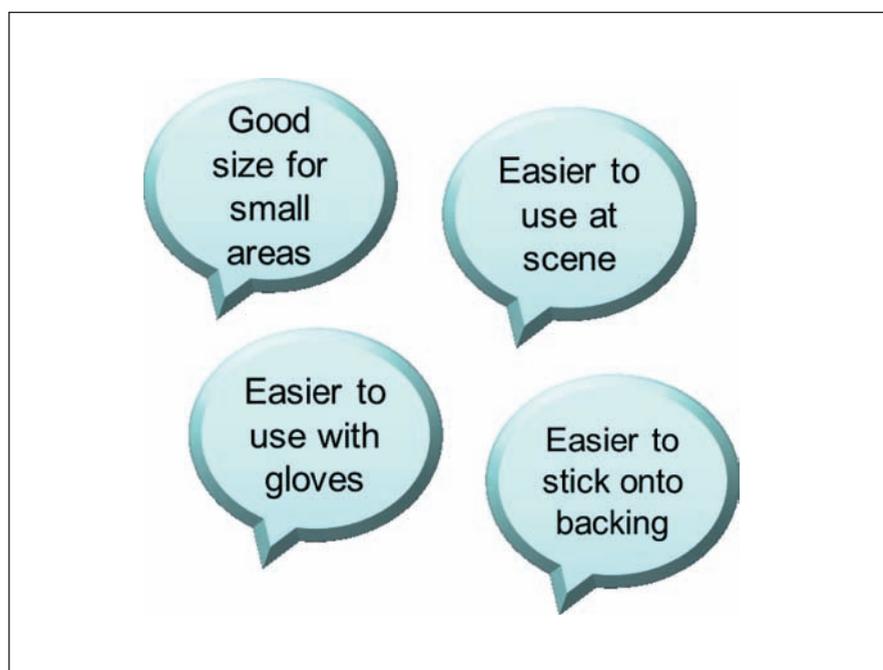


Figure 5. Comments on Easylift from Scenes of Crime Officers

The internal and surface features, cross sectional shape, colour and width of the fibres were as easily identified in Easylift as the traditional method and the OPD (and therefore the birefringence) were not significantly affected. Figure 7 shows an example of an acrylic fibre who's OPD has been measured at different tilting compensator positions whilst being analysed in the different environments. Some variation is expected between the different tilting compensator positions due to subjectivity in this analysis method. The differences between the Depex, Easylift tape and Easylift tape and slide are explained by this subjectivity but the differences in OPD seen in the J-Lar tape are due to the birefringent material of the tape and backing used which causes interference when analysing the OPD of the fibre. These results show that fibre analysis using PLM is not possible under normal tape but by utilising the new tape lifting system, analysis can be carried out *in situ* without requiring the fibre to be removed from the tape.

Future Work

This novel system is currently being patented (patent application numbers 10735037.3 [European] and 13/382208 [USA]). Staffordshire University are currently working with the Netherlands Forensic Institute to further establish the utility of this system and with major suppliers of forensic science equipment and consumables to refine its manufacture.

Background material sourced from Jackson, A, Gwinnett, C (2013) Easylift: A Novel Tape Lifting System, Interfaces, Forensic Science Society, 73, January-March 2013, pp 22-23

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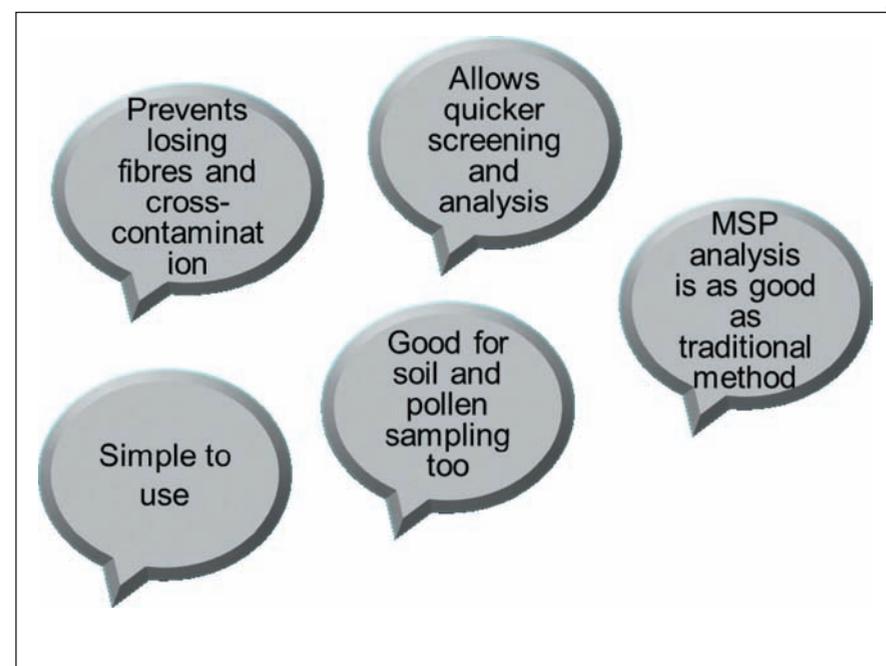


Figure 6. Comments on Easylift from forensic practitioners who analyse fibres and other particulates in casework (MSP stands for microspectrophotometric).

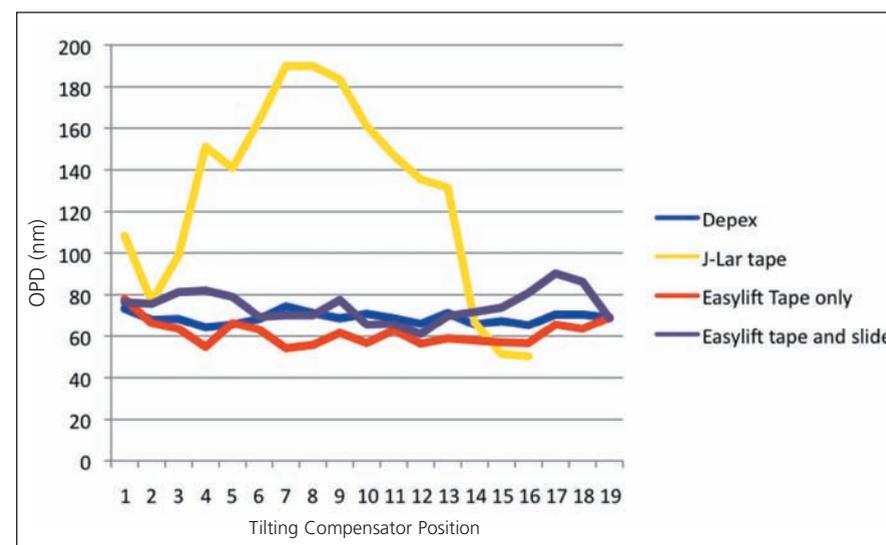


Figure 7. OPD measurements at different positions of a tilting compensator for an acrylic fibre held in depex, Easylift tape, Easylift tape and slide and J-Lar tape.