Recovering Latent Fingerprints from Duct Tape after Removal from Various Surfaces using Dry Ice Acetone Slush

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ABSTRACT

Duct tape has been used to facilitate different crimes, and criminals utilize duct tape in a variety of ways. Victims of a violent crime may be bound with duct tape, or duct tape may be used to package items related to criminal activity. The purpose of this study is to examine how a dry ice/acetone slush reduces the adhesive properties of duct tape and how the removal affects the quality of recovered fingerprints.

INTRODUCTION

Fingerprints are composed of minute raised ridges known as friction ridge skin, which contain pores that naturally secrete heterogeneous materials from skin glands. Majority of the fingerprint residue is composed of sebaceous material, known as sebum, which is principally composed of lipids. Fingerprints exhibit themselves in two manners: patent and latent. Patent fingermarks are ones easily visible to the human eye, whereas latent fingerprints are hidden or invisible (Lennard, 2007).

For latent prints, a chemical developer must be used to make the prints visible. Common developers are: (1) cyanoacrylate (super glue) fuming is used to develop latent fingerprints on non-porous surfaces (glass, plastic, smooth surfaces) and the quality of the fumed fingerprint is enhanced with Ardrox dye for fluorescence; (2) ninhydrin; (3) 1,8-diazafluorene-9-one (DFO) reacts with amino acids in the prints and produces a purple color (Jasuja et al. 2008); (4) Wetwop, a black powder suspended in a liquid, specifically made to develop prints on the adhesive sides of tape; and (5) crystal violet (gentian violet), a dye stain.

To separate adhesive tapes from various surfaces, chilling agents are used to reduce the adhesive properties, making it easier to separate without damaging the fingerprint (Stephens et al. 1999). Liquid nitrogen has been successfully used for this purpose, but it is not easily accessible and is relatively expensive. For these reasons, the use of dry ice and acetone is being explored.

PRELIMINARY EXPERIMENTS

Six different brands of tape were tested: ScotchBlue™ Painter's Tape (2), 3M™ Tough, 3M™ All-Weather, Shurtape™ Double-Sided, and Gorilla™ Tape to observe how adhesive tape, fingerprints, and dry ice interact. The fingerprints were placed on the adhesive side of each duct tape and then wrapped around various surfaces (glass, wood, and metal).

After removal, five developing methods were tested to develop latent fingerprints: superglue fuming with Ardrox dye, ninhydrin, DFO, Wetwop, and crystal violet

EXPERIMENTS

Four brands of duct tape were used: 3M™ Tough, 3M™ All-Weather, Shurtape™, and Gorilla™ Tape. Both ScotchBlue™ Painter's Tape were removed due to the fragility of the tape. In the experimental stage, each duct tape was removed from wood, metal, and glass using a dry ice acetone slush. The fingerprints were placed on the duct tape by handling it as a criminal would by ripping it and normally depositing four fingerprints across the tape

Latent fingerprints were developed with five developing methods. The recovered latent fingerprints were photographed using a Canon EOS Rebel T6 and a Leia S9D Stereomicroscope.

The quality of recovered latent fingerprints will be graded on a scale of 0 to 4 based on the quality of developed fingerprint, ridge and minutiae detail.

DATA

Table 1: Preliminary Experiment Data

	Blocks of Dry Ice			Crushed Dry Ice			Powdered Dry Ice		
	Glass	Metal	Wood	Glass	Metal	Wood	Glass	Metal	Wood
Scotch Wood and Walls	±	±	+	n/a	n/a	n/a	n/a	n/a	n/a
Scotch Multi-Use	0	-	+	n/a	n/a	n/a	n/a	n/a	n/a
Shurtape	0	0	-	±	±	±	+	-	+
3M All-Weather	+	+	+	+	-	+/-	+	+	+
3M Tough	-	±	±	+	0	+/-	+	±	+
Gorilla Tape	0	±	±	+	0	+/-	+	±	-

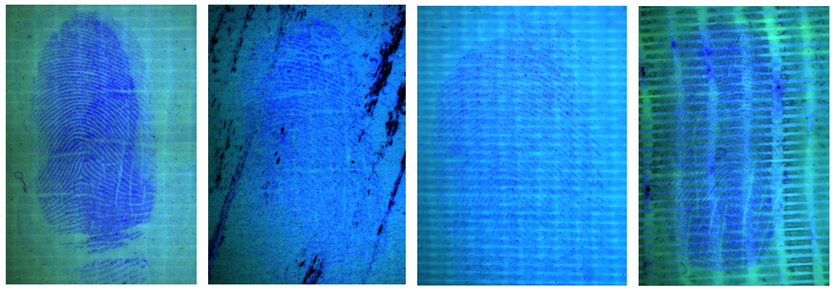

Figure 1. Development with crystal violet (a) Shurtape™, (b) Gorilla™ tape, (c) 3M™ Tough, and (d) 3M™ All-weather

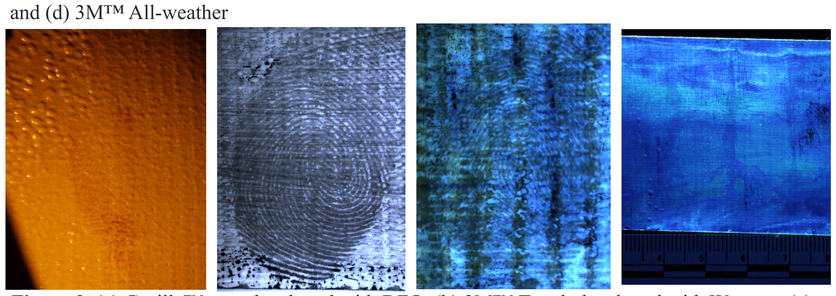

Figure 2. (a) Gorilla™ tape developed with DFO, (b) 3M™ Tough developed with Wetwop, (c) 3M™ All-Weather developed with Wetwop, and (d) 3M™ Tough developed with superglue and ardrox dye

Table 2: Average for Graded Fingerprints

	Cyanoacrylate Fuming w/ Ardrox Dye			DFO followed by Ninhydrin			Crystal Violet			Wetwop		
	Glass	Wood	Metal	Glass	Wood	Metal	Glass	Wood	Metal	Glass	Wood	Metal
3M All-Weather	0	1	0.5	-	-	-	3	2.75	3	3.25	2	2.5
3M Tough	3.25	2	1.75	-	-	-	1.66	1	2.33	2	2	2.5
Shurtape	3	2.75	3.25	0.5	0.25	0.25	3.5	2.75	3	2.8	2.8	3
Gorilla Tape	1.25	1.25	1.25	0.5	0.5	0	2.33	1.33	2.25	-	-	-

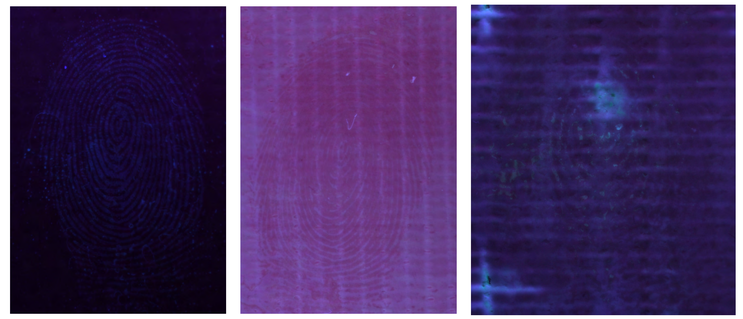

Figure 3. Development with cyanoacrylate fuming and ardrox dye (a) shurtape, (b) gorilla tape, and (c) 3M All-weather

RESULTS AND FUTURE DIRECTIONS

Thus far, the surface removed from does not seem to affect the quality of developed fingerprints, however, when removing duct tape from the untreated wood (a porous surface), some wood is being pulled up along with the tape. This could be problematic because it causes interference when viewing the developed print (Figure 1B).

Crystal violet (Figure 1), Wetwop (Figure 2B and 2C), and superglue fuming with Ardrox dye (Figure 2D & 3) have yielded gradable fingerprints. Although, DFO and Ninhydrin, which are developed separately, produces some partial prints, but overall does not develop any (Figure 2A). To address this issue, DFO and ninhydrin will be combined when developing latent fingerprints.

Shurtape seems to be yielding the best quality of latent fingerprints, shown in Table 2. 3M® All-Weather duct tape does not yield any developed fingerprints due to the ridges in the tape; most developing methods get absorbed into the threads, making it difficult to pick out the fingerprint. However, development with crystal violet was able to produce faint or partial prints on 3M® All-Weather.

Level 1 and 2 details can be seen in prints

A future direction could look at the chemical composition of latent fingerprints could be analyzed to see if acetone or dry ice alters the chemical composition. Additionally, removing duct tape from plastic bags and crumpled duct tape.

This research could further analyze to see if the removal process affects the ability to recover DNA evidence.

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