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Latent fingerprints on different type of screen protective films

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Abstract: The purpose of this research was to study the quality of latent fingerprint on different types of screen protective films including screen protector, matte screen protector, anti-fingerprint clear screen protector and anti-fingerprint matte screen protector by using black powder method in developing latent fingerprints. The fingerprints were performed by 10 volunteers whose fingers (right index, right thumb, left index and left thumb) were stubbing at different types of screen protective films and subsequently latent fingerprints were developed by brushing with black powder. Automated Fingerprint Identification System (AFIS) counted the numbers of minutiae points from 320 latent fingerprints. Anti-fingerprint matte screen protective film produced the best quality of latent fingerprint with an average minutiae point 72.65, followed by matte screen protective film, clear screen protective film and anti-fingerprint clear screen protective film with an average minutiae point of 155.2, 135.0 and 72.65 respectively. The quality of latent fingerprints developed between a clear and a matte surface of screen protective films showed a significant difference (sig>0.05), whereas the coat and the non-coat with anti-fingerprint chemical revealed a non-significant difference (sig<0.05) in their number of minutiae points.

Keywords: Screen protective film, Latent fingerprints, Black powder method, Anti-fingerprint coating.

1. Introduction

Physical evidences are an important role for crime scene. To resolve the lawsuit, investigating, collecting and recognizing those evidences are required. Fingerprints often and still are respected to be one of the valuable kinds of physical evidence in identification (Samuel, 2008). Two fingerprints have never been found alike in many billions of humans. In addition, fingerprints are relatively persistent when they compare with other visible human characteristics such as facial features, which tend to change with age (Adebisi, 2008). Latent fingerprint marks at crime scene may be found on many surfaces such as guns, knives, woods, glasses and smartphones which different surface (Rozman et al., 2014)

Fingerprint powder is widely used crime scene technician to detection and collection latent fingerprints that left behind crime scene. Powder methods is commonly used due to low cost, easy to develop latent print on many surface types and doesn't require much expertise (Low et al., 2015).

Nowadays, Smartphone and its application have been involved in our daily lives and offer much benefits (Smith, 2012). Smartphone is not just for calling but can do so many things including listening to music, scheduling appointments, controlling the equipment and so on which can be done by touching a finger on the smartphone. In some situation, smartphone is used for a tool in the crime such as for remoting bomb and to communicate between the terrorists. So smartphone is an important object that investigators, which usually used for collecting the fingerprint, evidenced to identification of person.

However, screen protective film is first accessory which choose by phone user for protect smartphone. Screen protective film will install on the screen of smart phone for protecting them from scratch and fingerprint which effectively to quality of the fingerprint due to the surface and chemical coating of protective film (Luis, 2014).

Screen protective film were produced and developed to respond the demand of consumers, so screen protective films were having many difference types. The most widely available, economical and easy to purchased type of screen protector, which used in this study is standard or clear screen protectors are usually thin and has shiny and smooth surface. Anti-glare and/or matte screen protectors have a matte finish to diffuse sunlight. Anti-fingerprint screen protective films are screening protective film that coating with hydrophobicity and oleophobicity chemicals.

The quality of latent print from development depends upon the surface of the object (Badiye and

Suan Sunandha Science and Technology Journal

Kapoor, 2015), so this article is part of a study the quality and the difference of latent fingerprints deposited onto different types of screen protective

film by using black powder dusting method for latent fingerprint detection and using Automated Fingerprint Identification System (AFIS) to determine number of minutiae.

2. Materials and Methods

2.1 Preparation of screen protective films for sample collection

In this research, 4 types of screen protective film were used including clear screen protective, anti-fingerprint clear screen protective, matte screen protective and anti-fingerprint matte screen protective. All types of films were made from polyethylene terephthalate (PET), clear types have a smooth surface and matte types have a matte finish, and anti-fingerprint types were made from polyethylene terephthalate with anti-fingerprint coating (Luis, 2014). Twenty films of each type were used. Almost of films have the size about length 5.44 inches and width 2.64 inches and each film was divided into 4 equal parts for repost the fingerprint mark of right index finger, right thumb finger, left index finger and left thumb finger, 4 figures that always developed for each touch-screen sample. After that installed films onto glass plate.

2.2 Latent fingerprint development

Three hundred and twenty mark of latent fingerprints from 10 volunteers - 5 men and 5 women deposited fingerprints. The volunteers were stabbed right index finger, right thumb finger, left index finger and left thumb finger onto 4 types of film with 2 films per types (duplication) at room temperature. Black powder was applied on stabbed fingerprint surface with a light-brushing action by rabbit hair, lifted with a tape and placed on a white backing card (Sodhi and Kaur, 2001).

2.3 Latent fingerprint examination

Collected latent fingerprints were counted the number of minutiae points by used Automated Fingerprint Identification System (AFIS) from SPEX Forensic Company, New Jersey, USA (Kenneth et al., 2011). The statistics were used to compare quality of appearance of latent fingerprint. The statistics were used in this experiment is *t*-test to compared and analyses the difference of latent fingerprint appearance

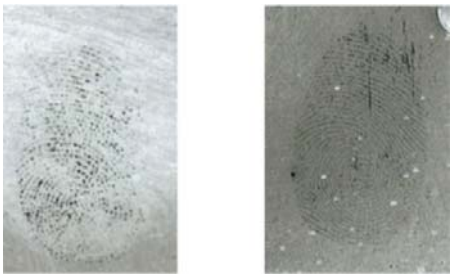

Figure 1. Latent fingerprints developed from clear screen protective films.

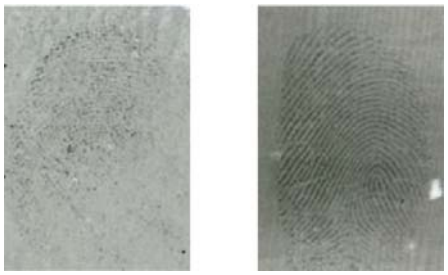

Figure 2. Latent fingerprints developed from anti-fingerprint clear screen protective films.

Figure 3. Latent fingerprints developed from matte screen protective films.

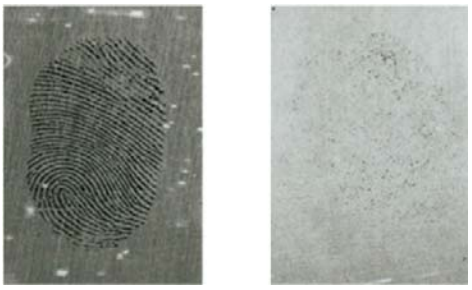

Figure 4. Latent fingerprints developed from anti-fingerprint matte screen protective film.

Suan Sunandha Science and Technology Journal

3. Results and Discussion

The result of the experiment, the visualization of latent fingerprints from each type of screen protective films has both of clear and faint fingerprints as show in Figure 1-4. Because of, the visualization of latent fingerprints was not depending on only surface but have many factors such as distortion, smearing and substance transferred to the surface etc. (Ulery et al., 2016). The number of minutiae points on each type of screen protective films from right index finger, right thumb finger, left index finger and left thumb finger of 10 volunteers which counted by used Automated Fingerprint Identification System (AFIS) as show in table 1. Anti-fingerprint matte screen protective film had the best quality of latent fingerprint, with average of the minutiae point 72.65 follow by matte screen protective film, clear screen protective film and anti-fingerprint clear screen protective film with average of the minutiae point 155.2, 135.0 and 72.65 respectively.

An independent sample *t*-test was conducted to compare the quality of latent fingerprint on different type of screen protective films, which compare between clear and matte surface, and between coating and non-coating with anti-fingerprint chemical as show as in Table 2-3.

The result from table 2 showed that comparison of the quality of latent fingerprints on clear surface and matte surface screen protective films. There was a significant difference (sig < 0.05) in the number of minutiae point. These results suggest that surface have an effect on the quality of latent fingerprints on screen protective films, which the numbers of minutiae points of matte surface screen protective films were more than clear surface screen protective films. Because of matte surface screen protective films were rough due to manufacturing process for anti-glare property (Marco et al., 2014). So the black powder from brushing and the secretions from the finger may be easily extracted to the surface.

Table 1. The total number of minutiae of each volunteer, counted by AFIS.

Screen protective films Type	Volunteer										$\bar{x}$
	1	2	3	4	5	6	7	8	9	10	
Clear	140.5	191.5	224	108	104	126	120	114.5	105.5	116	135.0
Anti-fingerprint Clear	7	180.5	114	100.5	29.5	66	79	68	66	16	72.65
Matte	133.5	209.5	172	190	248.5	175.5	123.5	86	103	110.5	155.2
Anti-fingerprint Matte	180	183	166	257	159.5	162	141.5	123	151	89	161.2

Table 2. Independent-sample *t*-test comparing matte and clear surface

Surface	N	Mean	SD	*t*	*p* value
clear	20	103.8250	55.19207	-3.355	.002
matte	20	158.2000	46.97323		

The comparison of the quality of latent fingerprint on anti-fingerprint coating and non- coating by used independent sample *t*-test method which analyze by used the number of minutiae points. There was no significant difference between the coating and non-coating with anti-fingerprint chemical (p>0.05) as shown in table 3.

The result suggest that anti-fingerprint coating haven't an effect on the quality of latent fingerprints on screen protective films, which the numbers of minutiae points of did not coating with anti-fingerprint chemical screen protective films were more than anti-fingerprint coating screen protective films in case of clear surface screen protective films, which anti-fingerprint clear screen protective films were coated with chemical for hydrophobicity and oleophobicity to self-cleaning, or easy-to-clean property (Wu et al., 2011). But in case of matte surface screen protective films the numbers of minutiae points of coating with anti-fingerprint chemical screen protective films were then did not coating type may be the anti-figure print coating did not have the effect to the rough.

Table 3. Independent-sample *t*-test comparing coating and non-coating with anti-fingerprint chemical

Anti-fingerprint	N	Mean	SD	*t*	*p* value
coating	20	116.9250	64.90930	10576	.123
Non-coating	20	145.1000	46.66640		

4. Conclusions

It is concluded from the result that the quality of latent fingerprint with the numbers of minutiae point of developed from different types of screen protective films were found anti-fingerprint matte screen protective is the best appearance of fingerprint films followed by matte screen protective film, clear screen protective film and anti-fingerprint clear screen protective film respectively. Surface conditions may one of dependent factors, which affected to the quality of latent fingerprints on screen protective films, which matte surface screen protective films were more than clear surface screen protective films, however, anti-fingerprint coating may not relate to the quality of latent fingerprints on screen protective films. For the future research will be conducted on appropriate method using for each type of screen protective films and affecting factors related to quality of latent fingerprint.

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