Finding the perpetrator using electricity and fingerprints

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Fingerprint examination

A crime occurred! When the forensic investigators arrive, they start with photographing and securing all the possible pieces of evidence. The pieces of evidence are visually inspected using white light or specific colours in combination with filters to detect impressed and patent fingerprints.

Impressed and patent fingerprints are directly visible to the human eye and could be found in respectively clay and blood. Another type of fingerprints that could be found at a crime scene are latent fingerprints; these fingerprints are not directly visible to the human eye, so a visualisation process is necessary.

The oldest fingerprint visualisation reagents are powders; these were already used in the 1800s. This technique is based on the adsorption of the powders to the oily and moisture components in the fingerprint residue. Over the years several types of powders have been developed (luminescent, reflective and absorptive powders) but also other reagents have been discovered.

In our (imaginary) crime scene, a letter, bloody knife and tape are found. Depending on the type of surface the best technique(s) are chosen. The first piece of evidence, the letter, is made of porous material and for that reason it will get 3 treatments by dipping the letter in 3 solutions. To secure the fingerprints, photos of the fingerprints will be made after each treatment. The first two reagents will react with the amino acids in the fingerprint resulting in a fluorescent (1st reagent) and purple (2nd reagent) fingerprint. The third reagent will react with the hydrophobic components of the fingerprint and will create a gray-silver colour.
The bloody knife and tape are non-porous materials. They will be fumed with superglue which results in a white deposit on the fingerprint. Afterwards several (blood) colouring treatments can be applied.

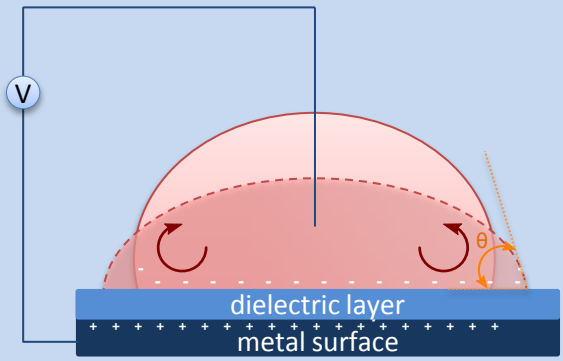
The fingerprint as identification method

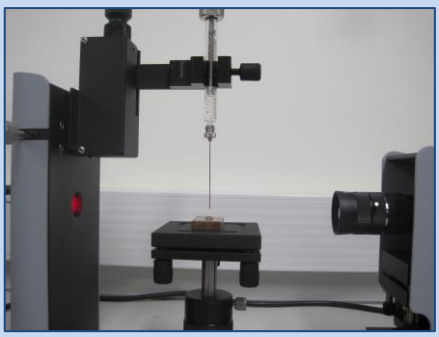
It is widely assumed that every person has an unique fingerprint. This makes the fingerprint extremely suitable for the identification of a person and in a forensic context, connecting a person to a crime.

For this identification, the fingerprint left at the crime scene is compared with the database and/or the fingerprint of a suspect. In this comparison, the features of the fingerprints are (individually) determined.

Some features:

- whorl
- loop
- (tented) arch
- bifurcation
- lake
- island





My research: fingerprints and electricity

Aged and damaged fingerprints are often difficult to visualise because the particles (amino acids, fatty acids,..) in the fingerprint are stuck to the surface, like a coffee stain, which makes them difficult to catch by the reagents. This is illustrated in the pictures below, in which a droplet illustrates one single ridge.

In this research, electricity will be used to detach the particles from the surface (so that they can react more easily with the fingerprint visualisation reagents) without disturbing the fingerprint ridge.

By connecting the droplet and the metal surface to an electrode, they become oppositely charged. This will result in attraction of the droplet by the surface and flatten out the droplet. Through this movement a flow inside the droplet will occur and the particles are no longer stuck to the surface and easier to approach by the visualisation reagents.

The change of the droplet shape will be determined by measuring the contact angle (θ) of the droplet as illustrated in the pictures at the left (top: schematic overview of the measurement, bottom: contact angle measurement instrument).

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