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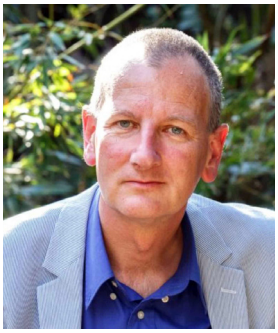

Latent DNA: "seeing" the location of DNA

Professor Adrian Linacre
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This short summary describes a recent breakthrough in the detection of DNA by researchers at Flinders University in South Australia that is set to make evidence recovery much more targeted.

By holding a knife, or loading a firearm, contact is made between a finger and the knife handle or a thumb and the cartridge case, passing on DNA from the hand to the surface or substrate of the weapon. This transfer is usually invisible and, if looking at the weapon without knowing that it was previously held, a forensic examiner has no means of "seeing" if DNA is present, that is, until now.

Current forensic practice concerning the collection of DNA from items that have been handled involves making informed guesses as to where DNA might have been left by the perpetrator of a criminal act. Door handles, steering wheels or knife handles often need to be checked. Crime scene operators use moistened sterile cotton or foam swabs, which are rubbed against the substrate in the anticipation that cellular material (the source of DNA) will transfer from the substrate to the swab. There is currently no way of knowing if any DNA is on the substrate or if any cellular material has been transferred to the swab.

These swabs are then labelled and stored prior to ultimately making their way to a forensic science laboratory where they are logged in and stored until a time becomes available for analysis. The analysis starts with a process called DNA extraction, which is generally now automated and can be performed in large batches, taking about an hour and a half to complete. Once the DNA is extracted from other biological material, the determination of how much DNA is present will be made by a process called DNA quantification, which can take a further two hours. It is only when the second process is complete that it becomes clear whether the original collection of DNA was successful. If there is no DNA present,

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it is still unclear whether it is because there was no DNA on the substrate in the first place or that none was transferred properly to the swab, making this a time-consuming process that wastes the reagents used in the attempt to extract and quantify DNA.

In a breakthrough developed by members of the forensic biology group at Flinders University, (Adrian Linacre, Piyamas Kanokwongnuwut and Jess Champion) it is now possible to closely monitor and record DNA on the substrate or DNA on the swab.

Although DNA alone is not visible, when it is combined or "stained" with a particular dye in a micro-tube or gel in the laboratory, the dye/DNA complex becomes visible under certain conditions. However, so many of these dyes are toxic or need specialist equipment to see the binding between the dye and the DNA. By scouring dyes available, one was found that is entirely safe, currently inexpensive, binds effectively to DNA and when bound becomes brightly fluorescent. At the same time as finding the perfect dye, which is called "Diamond Dye", a small microscope suitable for easy use and not requiring a dark room was sourced. Both the dye and microscope were not originally intended for use outside of a laboratory, but have been found to work perfectly for their unintended use in detecting latent DNA at the site of the crime. Figure 1[1] shows an example where only a tiny amount of dye is added to a glass surface that someone has touched and within 10 seconds a perfect finger mark can be observed under the microscope.

Applying Diamond Dye on a wide range of surfaces is now possible so that whatever a person touches, their deposited cellular material can be "seen" and the amount of cellular material recorded. Looking at Figure 1, each of the green dots is a source of DNA and their number (the amount of fluorescence) allows the viewer to determine whether there is sufficient DNA present to warrant further analyses. A full DNA profile is usually possible if there are more than 50 dots.

It was also realised that this same process can be applied to swabs. Once a swab has been taken at a scene it can be stored as normal, but the dye can be applied at any time as it is stable for at least four weeks with no loss in its efficacy. Again, the amount of fluorescence indicates whether DNA is present on the swab. This allows for very effective triaging of swabs, with only those exhibiting sufficient DNA being submitted for further analyses. Figures 2A and B show the process of DNA detection on a swab, showing a swab before (Figure 2A[2]) and after collection (Figure 2B[3]).

Further, the process of collection can be monitored in real-time and allows the evidence collector to examine in situ the swabbed surface to confirm whether all the cellular material was collected. The dye can either be applied to the substrate showing precisely where the DNA needs to be collected or the swab is rubbed over the substrate and the dye is then applied.

The saving of otherwise wasted laboratory time and reagents is potentially considerable.

Figure 1

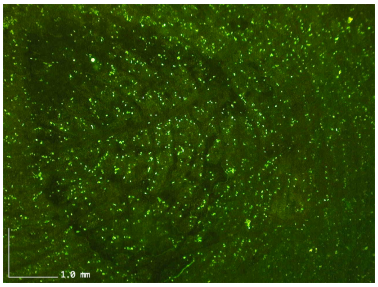

Figure 2A

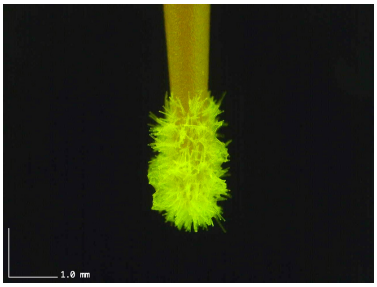

Figure 2B

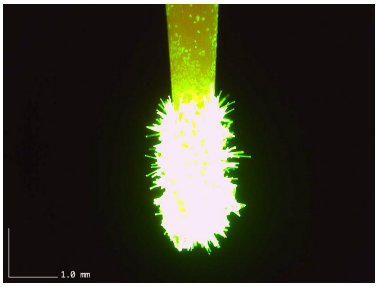

Figure legend

Figure 1[1] This figure shows a fingermark stained with Diamond Dye. Each green dot is a piece of cellular material and a source of DNA. The number of green dots can be assessed easily.

Figure 2A[2] Shows a swab prior to collection.

Figure 2B[3] Shows after the swab has been rubbed onto a fingermark.

On the swab in image B, a marked increase in fluorescence and cellular material, similar to Figure 1, is present on the tips of the swab fibres and on the shaft of the swab.