

## Messengers of the genome – not ‘having the wool pulled over your eyes’

Keeping an eye on provenance by inserting unique invisible markers into products is not a new science.

The concept of including covert messengers, in both products and print, is a security tactic that has proved its worth by assisting with the identification of fakes and falsifications for several decades. Developing secure solutions that can reach across market sectors, and be simultaneously agile enough to provide speedy confirmation of authentication is an exacting science.

Our Editor talks with Dr. James A Hayward, CEO of Applied DNA Sciences to discover how the appliance of science in this field is helping the authentication industry keep ahead of counterfeiters.



Dr. James A. Hayward

Building a business in authentication is not an easy task. Indeed, building a business in any field these days is difficult to say the least. Providing a unique sales proposition linked to a recognised need is essential if you are to stand a chance of success.

Applied DNA Sciences (APDN:OTCBB) has built a special business case for verifying the authenticity of products and of print over the last six years and is now based in Stony Brook, New York. Previously the business was situated in Los Angeles. The Company recently opened an authentication laboratory in Huddersfield, England in support of two important applications where recognising the markers present in stolen banknotes and valuable branded wool requires very specific qualities to be present in the verification system.

For those readers who are not familiar with the idiom ‘having the wool pulled over your eyes’ the meaning refers to someone who is fooled into accepting an untruth. In this respect, that something is fake or unauthentic.

Protecting the provenance of wool, right through the supply chain is essential in the textile industry since the best products attract the highest prices. ‘The Wool Mark’ is an international certification system that was established in 1964 to ensure that customers can depend upon the quality of wool purchased and that only

products made from 100% wool are able to carry the mark.

Natural materials such as wool and cotton have been notoriously easy to exploit in the past, since they can be mixed with impurities, lower quality of the same type of materials (eg lower grade cotton or wool) and substitute fibres in order to ‘spread’ the material further.

The growing conditions, along with the finishing processes being employed require specific attention to detail that if circumvented mean poorly performing product and dissatisfied customers.

Similar circumstances apply to the supply of cotton. More than 30% of the world’s consumption of cotton fibre crosses international borders before processing, a larger share than for wheat, corn, soybeans or rice. Coupled with the complexity of today’s international cotton trade, labels are removed from cotton bales during apparel manufacture, making it very difficult to trace the origin of the fibres.

This is complicated by the fact that there are two very distinctive types of cotton; Pima and upland cotton.

Pima cotton is a generic name for extra-long staple (ELS) cotton grown mostly in the United States, Australia, Egypt and Peru. It accounts for only a small percentage of all the cotton produced

but is favoured for the finish and quality of the fabric it produces. Therefore Pima cotton attracts a high price.

Upland cotton covers all other cultivated cotton varieties of the species and represents approximately 95% of what is currently grown worldwide. (*Gossypium hirsutum*, known as Upland Cotton, is the most widely planted species of cotton in the United States, constituting some 95% of all cotton production.

Worldwide, the figure is about 90% of all production for this species – from Wikipedia). A typical fraud in the trading of cotton would involve mixing cheaper product in with the premium product, and labelling it as containing 100% Pima cotton, in order to make a higher profit.

Straightforward methods of identification are therefore required to ensure that trading partners are not misled over the provenance of such materials. In some areas of the world, higher customs duties are levied on superior products and it is important that unambiguous methods of classifying consignments of finished and bulk raw material are available. Faking the provenance of cotton used to be a less risky way of growing rich than robbing banks. Not anymore.

Tracing stolen banknotes and linking them with a specific felony is also an

essential component in securing a satisfactory conviction in criminal trials. In this case, the ability to 'link' a batch of stolen notes with individuals present at the scene of crime, needs to involve an unambiguous marking system that supplies a code structure that can deliver an infinite number of combinations that can be used to 'recognise' each and every deployment.

Both applications require a different approach when a secure marking system is utilised to corroborate evidence and prove a point in a court of law. In both cases, the presence or absence of a secure marker can deliver significant outcomes.

"Because our clients require a variety of solutions to meet their specific needs, APDN offer two platforms for authentication. One system allows the physical material being protected to supply its own marker in a form of genotyping. The other system we provide delivers a unique marker that is designed to be applied to an individual product or process (SigNature® DNA)". Dr. Hayward told Product and Image Security in a recent interview.

Since all natural materials contain an individual genomic<sup>1</sup> structure, they also carry the means necessary to identify themselves at various points within the supply chain. By using the inherent DNA embedded within specific batches of natural material such as wool and cotton, and recording its structure, it is possible to create a template that can be

used to identify textiles and detect counterfeit or mislabelled products entering the supply chain. APDN refers to this system as BioMaterial Genotyping™ and it enables manufacturers to accurately identify their products and ensure that warranty claims are not abused. It's also useful for Customs and Enforcement agencies tasked with protecting borders and supply chains since tests can be applied to identify provenance with disposable field testing kits.

"Primary checking allows us to test with 100% accuracy for the presence of a 'rapid reporter' single molecule. Level two testing uses a polymerised chain reaction to confirm or deny authenticity and if required we can also offer laboratory based forensic authentication which can be used as conclusive evidence in court". Dr. Hayward continued.

By utilising the DNA naturally occurring in an organic molecule, APDN bypasses the need for approval from food safety standards agencies since no synthetic marker is being added to the product. The use of such systems to protect prestige wine and fine foods<sup>2</sup> also means that markers can be harvested from the product and combined with printing inks and materials used in packaging and labelling to protect against counterfeiting and refilling.

The introduction of APDN's other technology, SigNature DNA, provides protection for products, security print,

labelling and packaging in the form of additions of botanical DNA markers in inks and dyes. These DNA markers can also be applied through the direct marking of goods with non impact delivered codes in the form of ink jet inks.

SigNature DNA can also be used to protect synthetic materials that are converted into textiles such as polyester. In much the same way that BioMaterial Genotyping is used to identify natural fibres, SigNature DNA can be applied to the entire surface of non-natural materials as a means of authentication. The only difference is that with SigNature DNA applications it is possible to recognise individual codes rather than the 'shared' genetic characteristics that are present in bulk batches of the same natural material (eg all Pima cotton grown in the US shares common genetic characteristics).

SigNature DNA is also an important tool for 'linking' those involved in a crime to the event itself so that any denial of participation is pointless. "DNA provides a forensic trail of evidence linking the criminal to the crime, and DNA authentication supports the enforcement programs of the various law enforcement groups, such as the Police, Public Prosecutors and The Courts," Dr. Hayward informs.

Loomis UK<sup>3</sup>, a cash-handling company that moves over £150 billion in cash annually, uses APDN's SigNature DNA to protect its cash boxes. SigNature DNA is automatically sprayed onto the enclosed currency along with an intense dye whenever a Loomis Cash Box containing SigNature DNA is disturbed. Any tampering with the cash-in-transit boxes will result in the money and likely the offenders and their personal property being contaminated. SigNature DNA can forensically link an offender with an individual crime scene, making it that much more difficult to deny their involvement.

Last May, APDN announced that it had successfully authenticated SigNature DNA on stolen bank notes received from the UK Police, assisting them in the prosecution of the alleged perpetrators.

APDN completed the DNA analyses in its new Authentication Laboratory in Yorkshire.



Forensic authentication evidence can be used in court

The bank notes recovered by the UK Police and submitted to APDN for forensic authentication, appeared to have been washed multiple times by the criminals using harsh chemicals, in an attempt to remove the dye that stained the cash during the robbery. SigNature DNA resisted removal and was still readily detectable using APDN's proprietary methods.

The Company can supply an unlimited number of unique DNA codes enabling the unequivocal authentication of bank notes and other marked items. The same DNA markers detected on the recovered bank notes were also detected on personal items belonging to the suspects in the investigation. SigNature DNA markers are helping link criminals to stained notes, clothing, mobile phones, automotive parts, and any other items that come into direct contact with the perpetrator. Since SigNature DNA is extraordinarily

persistent, even the most savvy criminal will not be able to detect or remove it. Being tied to the crime with SigNature DNA marked evidence can dramatically increase the likelihood of conviction. The accumulation of APDN's forensic DNA evidence combined with other forms of evidence will ultimately assist in finding the perpetrators guilty.

The marking of metal components is also possible using this process. Very recently the Company successfully applied its proprietary markers onto the surfaces of intact metal, with the potential to assign unique DNA sequences for each metal application. Counterfeit metal materials have been detected in everyday building and construction materials, electronic components, after-market car parts, public rail and bus transportation materials, and components used in military and commercial aircraft.

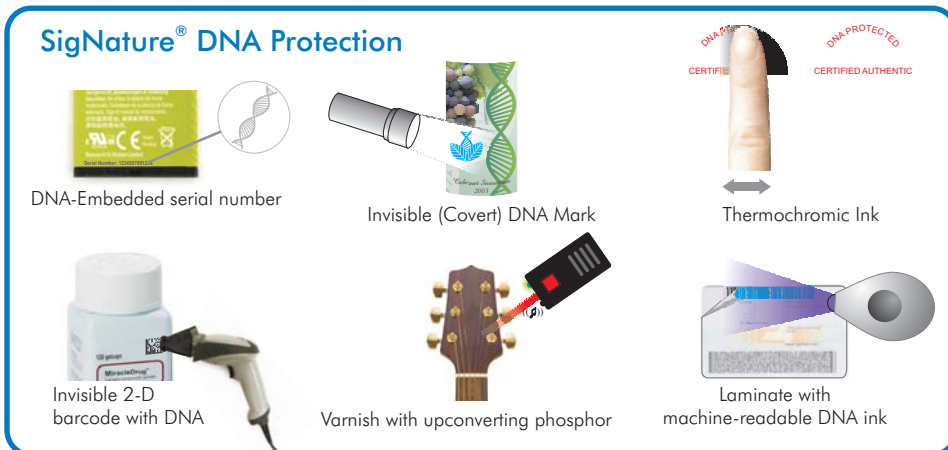
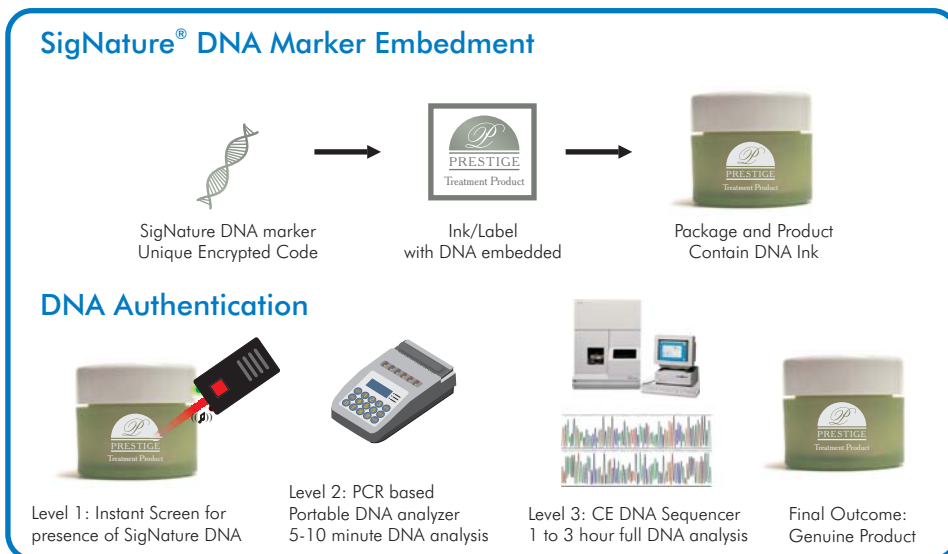
Dr. Hayward, adds, "Typically, metal counterfeits are only distinguished after a very thorough visual check. Organised efforts to counterfeit metal components can be curtailed easily by the application of a unique forensic DNA marker that can even be used to distinguish between various products."

"Aluminum, copper, tin and steel can all be protected with SigNature DNA and authenticated should there be any doubt as to their authenticity. The persistence of SigNature DNA markers, even after attempts to wash or remove them, has already been validated in laminates, thermal transfer ribbons and a wide range of security inks and substrates". Dr. Hayward concluded.

The Company serves a number of vertical markets which most importantly include inks, packaging and labelling. The use of printing ink as an authentication feature is widespread in security print and primary packaging. Features such as luminescence, optical variability and colour change through thermochromic reaction can all be reinforced and supported by the addition of a totally overt security device such as DNA. Since counterfeiters can often identify and mimic these protective measures to a degree, the addition of a totally secure forensic tracer that cannot be copied is a valuable asset in product and document protection. The markers are compatible with flexography, offset and gravure and can even be added to adhesives and varnishes.

In circumstances where very high security is required, such as in identity and currency printing the DNA markers can be combined with laminates and machine readable inks to provide robust forensic evidence when it is needed in Court.

As the market for secure covert markers continues to grow, alongside the rise in product related fraud, the need for flexible and cost effective measures such as those offered by APDN will become impossible to ignore.



<sup>1</sup> A genome is the sum total of all an individual organism's genes

<sup>2</sup> Recent reports from Japan indicate that many Sushi restaurants mislabel their fish leading to less expensive items being served in place of premium produce

<sup>3</sup> Known previously as Brinks UK. The cash in-transit company was acquired by Loomis earlier in the year.