DatatraceDNA® – A Novel Authentic Technology for Forensic Detections and Identifications

Xinshi Luo[*1,2], Sivakumar Balakrishnan[2], Peter Osvath[2], Gerry Swiegers[1,2]

1. DatatraceDNA Pty Ltd, Suite 9, 19 Rodborough Road, Frenchs Forest, NSW 2086, Australia
2. CSIRO Molecular and Health Technologies, Private Bag 10, Bayview Avenue, VIC 3168, Australia

Tel: +61-3-95452441 Fax: +61-3-95452446 Email: Xinshi.Luo@csiro.au

Abstract: This paper describes a newly developed forensic marker technology, known as Datatrace DNA (Digital Nanoparticle Authentication), which offers a groundbreaking approach to counterfeit security protection through nanotechnology that is invisibly embedded within the molecular structure of a manufactured product. Extremely tiny quantities of some security compounds (called security markers) can be incorporated into various sensitive materials, such as explosives, identification documents, printing inks and weapons. Each marker possesses unique or unusual properties that are detected by the Datatrace hand-held electronic reader, known as "The Authenticator". As such, the Datatrace system provides a secure and invisible barcode for authentication. The DatatraceDNA® markers are very stable and cannot be destroyed even at 1000 °C, which provides a life-time protection for the labelled products. Therefore, this novel technology offers the potential to reduce criminal activities by deterring counterfeiting and theft, and assisting in the recovery and return of assets that have been stolen.

Key words: sensing technology; security devices; nano-particles; security markers

1. Introduction

It is well-known that industrial and commercial counterfeiting is a serious threat to the integrity of world trade and global development [1, 2]. This growing crime is causing increasingly severe economic impacts to both business owners and consumers.

To meet the increasing demands from modern life, research scientists are keenly seeking a new technology which can be used by manufacturers, business owners and customers to secure and protect their products against counterfeiting. The new technology includes establishing a rapid, secure, field-based system for tracking and authentication of sensitive materials, and the data base of new security markers that have unique, secure, robust, versatile and durable properties. An important requirement for the new security markers is that they can be easily incorporated into various products at forensic level without changing the product's properties. In addition, the security markers need to be difficult to reproduce to make each asset they are applied to unique and individual. In the competition for developing such kind of new generation security technology, we have prepared various new security markers and have successfully applied them to a wide range of industry applications, including post-detonation identification of military and civilian explosives, authentication and identification of valuable identity documents and products including passports, automotive, marine, clothing, printing inks and industrial materials.

In this presentation, an application of the forensic DatatraceDNA® security markers to printing inks with different concentrations for authentication and identification of valuable documents is described. Through monitoring and measurement of the changes in the measurable properties of the security markers, a highly reproducible and error-free detection of the incorporated DatatraceDNA® markers in extremely small quantities has been

E-FORENSICS 2008, January 21-23, Adelaide, Australia

DOI 10.4108/e-forensics.2008.2844

demonstrated. This is very promising for authentication system.

2. Experimental

Security printing inks were prepared by adding different quantities and types of DatatraceDNA® security markers (see Figure 1) into Matrix Eco Pms trans-white ink (from DIC Colortron Pty Ltd), and mixing thoroughly at 22.5 ^{o}C with humidity 50%. A high speed ink printing unit (IGT printability tester AIC2-5), which can automatically control the temperature of inks and can test four inks simultaneously through a microcomputer controlling system, was used to prepare the security ink samples. The inking unit consists of one cylinder with sidewise oscillation, one driven cylinder with a top-roller, and four printing disc holders at the top of the top-roller. The inks were put into injection syringe and squeezed onto the rubber top-roller, and then started running for 5 seconds and distributing for 10 seconds, followed by moving the disc back into the ink printing machine for printing samples. All test prints were measured and compared using the portable DatatraceDNA® "Authenticator" reader. All signal measurements were performed on the hand-held reader shown in Figure 2.

Fig.1. *DatatraceDNA® business trade markers*

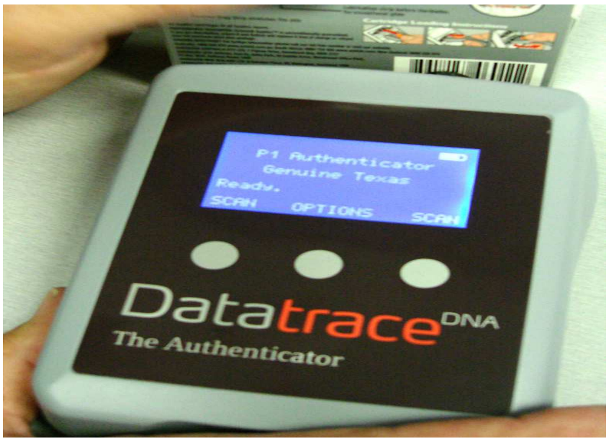

Fig.2. *Hand–held DatatraceDNA® reader*

3. Results and discussion

An important challenge for this security technology is that the physical properties of the trace markers have to be stable, unique or specific, and can be detected easily when they are applied to different media under different conditions. With this consideration, we need to evaluate the reproducibility for detecting DatatraceDNA® security markers under different printing conditions. As the paper quality and the ink content, GSM (gram per square metre), are the two most important factors that determine the printing quality, we have applied DatatraceDNA® security markers I and II inks to two grades of paper, glossy and mat respectively, with different GSM printing conditions. The signal intensities were measured, and the reliability and stability of the markers as forensic security tracers can be evaluated through an analysis of the changes of the intensity ratio of the two signals. The measured results for DatatraceDNA® security markers I and II are listed in Tables 1 and 2 respectively. The intensity ratio of the two signals for both markers I and II was observed to be very stable with a maximal error less than 0.4%, demonstrating that our DatatraceDNA® security markers can be easily detected with high reliability under different printing conditions, which are very promising for security applications such as fast forensic identifying, tracking, detecting, and protecting authentic products against counterfeiting.

It is known that standard deviation is another useful means for evaluating the reliability of measurement results. With the measured signal intensity ratio (i.e. the security code) values in Tables 1 and 2, the standard deviations for the accuracy of security code of DatatraceDNA® markers I and II can be calculated, which are σ_1^2 = 0.0000096, σ_1=0.0031, σ_2^2 = 0.000009, σ_2= 0.0030 respectively. These small deviations further suggest that both DatatraceDNA® security markers I and II can maintain a high stability with a unique and specific code under different conditions, thus they are suitable for using as security codes in detecting and authentication of various products as demonstrated in Figures 3 and 4.

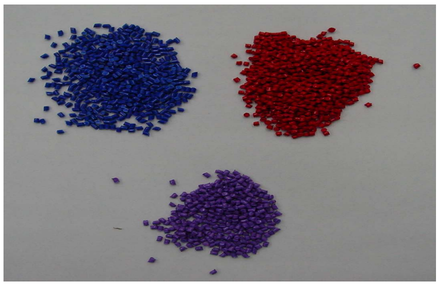

Fig.3. *Compounded into* coloured polymers

Fig.4. *Incorporated into polymer fibres*

Table 1. *The variations of signal 1 and signal 2 for DatatraceDNA® security marker I under different printing conditions and concentrations*

Marker concentration and paper type		Intensity (counts)	GSM (g/m^2)	Two Signals	Signal 1:signal 2 ratio
1%	Sample1 (glossy paper)	84.99	2	Signal 1	7.030
		12.09	2	Signal 2	
	Sample 2 (mat paper)	104.7	3	Signal 1	7.026
		14.90	3	Signal 2	
2%	Sample 3 (glossy paper)	170.13	2	Signal 1	7.03
		24.20	2	Signal 2	
	Sample 4 (mat paper)	200.0	3	Signal 1	7.020
		28.50	3	Signal 2	
3%	Sample 5 (glossy paper)	250.1	2	Signal 1	7.025
		35.60	2	Signal 2	
	Sample 6 (mat paper)	300.1	3	Signal 1	7.021
		42.74	3	Signal 2	

Table 2. *The variations of signal 1 and signal 2 for DatatraceDNA® security marker II under different printing conditions and concentrations*

Marker concentration and paper type		Intensity (counts)	GSM (g/m^2)	Two Signals	Signal 1: signal 2 Ratio
1%	Sample 7 (glossy paper)	53.00	2	Signal 1	7.400
		7.160	2	Signal 2	
	Sample 8 (mat paper)	65.70	3	Signal 1	7.420
		8.850	3	Signal 2	
2%	Sample 9 (glossy paper)	106.19	2	Signal 1	7.410
		14.33	2	Signal 2	
	Sample 10 (mat paper)	124.66	3	Signal 1	7.420
		16.80	3	Signal 2	
3%	Sample 11 (glossy paper)	156.24	2	Signal 1	7.426
		21.04	2	Signal 2	
	Sample 12 (mat paper)	187.5	3	Signal 1	7.422
		25.26	3	Signal 2	

4. Conclusions

We developed novel DatatraceDNA® security markers, which possess unique or unusual physical properties that can be effectively incorporated into various products, such as driver licenses, passports, identifications, medical and social security documents in the form of printing letters, numbers, and/or specific patterns and features. Our DatatraceDNA® security markers in the printing inks can be easily detected by hand-hold readers with an extremely high reliability, thus they provide a novel solution for fast forensic identifying, tracking, detecting, and protecting authentic products against counterfeiting.

Acknowledgements: We would like to thank Monash National Printing Lab for their kind assistance in preparation of our security ink samples.

References

[1] A. Herrigel, RFID Theft and Countermeasures, *in Proc. of the IST/SPIE, Volume 6075, Optical Security and Counterfeit Deterrence Techniques V* (18th Annual Symposium on Electronic Imaging science and Technology,17-19 January 2006, San Jose), p. 607510

[2] T. Kaye and R. Thyer, Spray Coatings: Cold Gold-cool Moves, *In CSIRO Solve Magazine*, 6 February 2006.