B181 Non-Destructive Biological Evidence Detection and Collection Using the ESDA®-Lite

Dane T. Plaza, 10430 Furnace Road, Ste 107, Lorton, VA 22079; Jamia J. Mealy, MS, Bode Technology, 10430 Furnace Road, Ste 107, Lorton, VA 22079; Jack N. Lane, BS, Bode Technology, 10430 Furnace Road, Ste 107, Lorton, VA 22079; Michael N. Parsons, MS, 10430 Furnace Road, Ste 107, Lorton, VA 22079; Abigail S. Bathrick, MFS, 10430 Furnace Drive, Lorton, VA 22079; and Donia Slack, 10430 Furnace Road, Ste 107, Lorton, VA 22079*

After attending this presentation, attendees will understand the basic operating principles of collecting human DNA evidence using the Electrostatic Detection Apparatus (ESDA®)-lite. Additionally, attendees will learn of the potential forensic applications of utilizing alternative collection methodologies such as dry-swabbing and the ESDA technique for non-destructive biological evidence detection and collection from paper substrates.

This presentation will impact the forensic science community by providing a confident approach to non-destructive biological evidence sampling from paper substrates. This technique would allow forensic DNA analysts to detect and collect biological materials from an evidentiary item without damaging its structural integrity and/or interfering with any subsequent examinations. Non-destructive collection of biological samples for DNA processing would preserve the physical integrity of evidentiary items to allow for more thorough evaluations by other forensic disciplines subsequent to DNA processing. The additional information gained from items processed in this manner could aid in the conviction or exoneration of individuals associated with evidentiary items containing touch DNA, such as questioned documents, entry-point surfaces, clothing, and other handled items. Evidence processed in a non-destructive manner would also remain available for future evaluations that could prove pivotal to the outcome of a cold case investigation and/or criminal retrial. All of the tools and techniques suggested are either relatively inexpensive or are already available in crime laboratories and could easily be incorporated into standard laboratory operating procedures.

The ESDA®-lite was systemically evaluated for its ability to non-destructively collect DNA from latent fingerprints deposited on various paper substrates for Short Tandem Repeat (STR) DNA profiling. Fingerprints were deposited on a variety of paper substrates that included resume paper, cotton paper, magazine paper, currency, copy paper, and newspaper. A total of 162 samples were prepared. For each collection technique, 54 latent fingerprints were sampled. Three DNA collection techniques were performed: ESDA collection, dry swabbing, and substrate cutting. Efficacy of each collection technique was evaluated by the quantity of DNA present in each sample and the percent profile generated. For each collection technique and substrate type, the DNA quantities were averaged across all three donors (Table 1). Large standard deviations were observed due to the wide range of DNA quantities deposited by the different fingerprint donors. Across all substrates, full and high partial profiles were generated for 65% of the samples collected with the ESDA technique, 93% of the samples collected via dry swabbing, and 52% of the samples collected with a destructive collection technique. Profiles in which 70% of the alleles (22 of 32 alleles or 11 loci) were obtained were considered to be high partial profiles.

Table 1: DNA quantity (ng) present in fingerprint samples collected via the ESDA, dry swabbing, and destructive (cutting) collection techniques.

Paper Substrate	Mean DNA Quantity (ng)		
	ESDA	Dry Swabbing	Destructive
Resume	0.367 ± 0.601	0.521 ± 0.348	0.061 ± 0.097
Cotton	0.217 ± 0.264	0.547 ± 0.519	0.000 ± 0.000
Magazine	0.332 ± 0.308	1.049 ± 1.186	0.130 ± 0.149
Currency	0.320 ± 0.696	0.623 ± 0.319	0.187 ± 0.184
Copy	0.170 ± 0.185	0.798 ± 0.460	0.550 ± 0.881
Newspaper	0.170 ± 0.226	0.267 ± 0.245	0.677 ± 0.453

Both the ESDA and dry swabbing non-destructive sampling techniques outperformed the destructive methodology of substrate cutting. A greater number of full profiles were generated from samples collected with the non-destructive dry swabbing collection technique than were generated from samples collected with the ESDA; however, the ESDA also allowed the user to visualize the area of interest while non-destructively collecting the biological material. The ability to visualize the biological material made sampling straightforward and eliminated the need for numerous, random swabbings/cuttings. Based on these results, the non-destructive ESDA collection technique has great potential for real-world forensic implementation.

This project was supported by Award No. 2010-DN-BX-K193 funded by the National Institute of Justice, Office of Justice Programs, United States Department of Justice. The opinions, findings, and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect those of the Department of Justice.

DNA Typing, Non-Destructive Collection, DOMEX