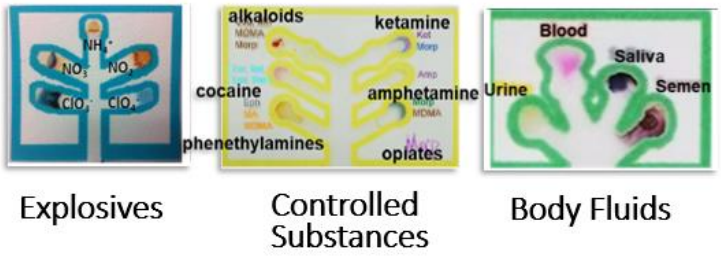
Moving Knowledge from Research to Impact

SUCCESS STORY

NIJ and Florida International University

Enabling Forensic Field Testing with Paper Microfluidic Devices



" I'm impressed with the potential for replacement wet color tests. The multiplexing capabilities have potential to address the challenges field forensics investigators encounter with non-pure, intermixed drugs as well as unknown powders."

—Dr. Michael Buerger, PhD, Professor of Criminal Justice, Bowling Green State University, and former New Hampshire police officer

Problem and Solution Synopses

Forensic investigators, law enforcement, and military personnel are often placed in potentially dangerous situations when they come across suspected drugs, explosives, and bodily fluids while in the field. These individuals may need to quickly detect and analyze chemical compositions of unknown substances to ensure safety and assess how they should proceed. Although numerous detection techniques are available to meet these needs, many are limited by various shortcomings (e.g. portability, caustic reagents, timely). For example, some techniques require large, expensive pieces of instrumentation that are typically not portable.

Paper microfluidics is a transformational technology that permits the development of very inexpensive analytical devices based on designs printed in wax-based ink on chromatography paper. These devices eliminate the need for bulky and sometimes caustic liquid reagents and are not much larger than a postage stamp. Because of their small size, low cost, easy storage, and user friendliness, these paper-based sensors can provide police and forensic evidence collection teams an easily stored and reliable tool for presumptive testing of unknown materials. With NIJ support, Dr. Bruce McCord at Florida International University (FIU) has developed a suite of paper microfluidic devices for forensic residue analysis applications, such as presumptive testing of explosives, serological stains and detection of seized drugs. These devices have been validated by the Miami Dade Bomb Squad and are currently being explored for commercial forensic applications.

Key Benefits

- Drives progress toward the incorporation of improved, low-cost, reliable, and easy-to-use presumptive testing devices.
- Utilizes well-known and specific colorimetric reactions already in use at forensic laboratories.
- Produces clear and distinguishable color differences within 5 minutes, that are easily visualized using a cell phone camera, image J , or density analysis programs.
- Provides presumptive multiplex testing (five to six tests simultaneously) that is reliable, has microgram sensitivity, and can be engineered to test a broad range of analytes.
- Operationally inexpensive (<$1 per device) and easy to design and manufacture using a paper wax printer, with stability of results up to 3 months and digital preservation.

NIJ Research

In McCord's laboratory, his team successfully engineered a suite of inexpensive paper devices utilizing well-known colorimetric reactions, which are activated by dissolving the unknown material in acetone or water and applying the solution to the base of the device. Results are interpreted based on the color of the sensor pads located on the device. Each paper device can perform five or more simultaneous analyses in approximately 5 minutes.

Disclaimer: *This success story was supported by Award No. 2016-MU-BX-K110, awarded by the National Institute of Justice, Office of Justice Programs, U.S. Department of Justice. The opinions, findings, and conclusions or recommendations expressed in this publication/program/exhibition are those of the author(s) and do not necessarily reflect those of the Department of Justice.*

Published: April 2019

More Information

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Research Support

The research presented in this success story was supported by National Institute of Justice (NIJ) grant 2012-DN-BX-K048: Paper microfluidic systems for rapid and inexpensive presumptive detection of drugs and explosives.

Collaborators

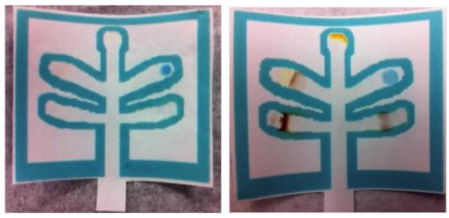
Dr. McCord would like to thank Inge Corbin, Lucas Blanes, Kelly Peters, Ling Wang, Giacomo Musile, Franco Tagliaro, George Duncan, Ashley Wardlow, Rosa Cromarte, Kathryn Chabaud, and Margie Phipps.

Bringing Research to Practice

The Miami Dade Bomb Squad successfully used these microfluidic colorimetric devices to conduct in-field pre- and post-blast testing of chemical residues. In addition, this research was presented at TEDx "*Fast, Easy, Cheap Explosives Detection*" and a Forensic Technology Center of Excellence (FTCoE) webinar titled "*Paper Microfluidic Devices for Fieldable Forensic Testing.*" Six peer-reviewed publications and more than 117 citations document Dr. McCord's research on the application of microfluidic colorimetric detection methods in future crime scene investigation. Additionally, this technology is covered by two U.S. patents—US10036738B2 (2018): *Paper microfluidic devices for detection of improvised explosives*; US9791434B2 (2017): *Paper microfluidic devices for forensic serology*. A spin-off project received additional support from NIJ and National Institutes of Health (NIH) to study gold nanoparticle aptamers for the detection of cocaine and other illegal drugs (2015-IJ-CX-K006).

The Future

Dr. McCord and colleagues are working to advance the detection capabilities for drugs and bodily fluids by broadening the range of analyte detection while enhancing the technique's sensitivity. Simultaneously, the McCord group is seeking partners who are interested in field testing validation and advancing the commercial application of these multiplexed and fieldable presumptive tests for crime scene and laboratory investigators.



Example of a test for explosives.

To learn more about this technique, please contact Elizabeth Garami at FIU's Office of Technology Management and Commercialization (egarami@fiu.edu). Stay informed about more products and services by requesting the FTCoE newsletter (ForensicCOE@rti.org).

Image Credits

Pages 1 and 2—Dr. Bruce McCord, FIU

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