

# Raman Spectroscopy:

## Identification of Synthetic Cathinones

### Overview

The problem of illegal narcotics continues to grow at an alarming rate worldwide. The types of narcotics routinely found by law enforcement, customs, and border patrol officers are no longer limited to typical street narcotics such as heroin, cocaine, and MDMA (ecstasy). Recent years have shown significant growth of street drugs collectively known as synthetic cathinones – also called “bath salts,” “plant food,” or designer drugs.

The use of these highly toxic drugs is increasing at an alarming rate. In 2010, U.S. Poison Control Centers received 303 calls related to synthetic cathinones in the entire year. From January to October 31, 2011 that number jumped to 5,625 calls and is expected to continue increasing. This type of explosive growth is considered similar to the PCP growth seen in the 1970s.

Cathinone is a well-known psychoactive compound controlled under Schedule I of the 1971 United Nations Convention on Psychotropic Substances. The synthetic or “designer” cathinones bursting onto the market in recent years have appeared as powders, tablets, and capsules and are widely available online and in retail stores. Several of these new types of drugs, most notably mephedrone and 4-methylephedrone or MCAT, have been made illegal in many countries (mephedrone as early as 2008 in Sweden). See box below for a brief overview of current global legislation.

As quickly as countries make a certain drug type or derivative illegal, modified substances make their way into the market to circumvent the new laws. With drug targets evolving so rapidly, law enforcement agencies must keep pace by deploying the latest field- and laboratory-testing methods.



Synthetic cathinones are often intentionally mislabeled and include “not for human consumption” to avoid prosecution.

### Raman Analysis

There has been growing interest in Raman spectroscopy for the safety and security sector, specifically narcotics screening and identification.

Raman spectroscopy has been extensively deployed for use in homeland security applications, largely due to the high chemical specificity, with each chemical substance having a unique spectral fingerprint.

Handheld Raman spectrometers also offer several key tactical advantages over other testing methods. As noted, Raman offers highly specific analysis results. Raman is also nondestructive and non-contact, enabling analysis through sealed glass and plastic containers. This feature helps reduce exposure to ensure officer safety, and is particularly useful for preserving evidence. Further, handheld Raman instruments can be taken directly to the point of need, which could be on the street, in a police station, or as a primary screening tool in a forensic laboratory.

## Health Impact

***“If you take the worst attributes of meth, coke, PCP, LSD and ecstasy and put them together, that’s what we’re seeing sometimes.”***

Mark Ryan, Director, Louisiana Poison Center, as quoted in The New York Times, “An Alarming New Stimulant, Legal in Many States,” July 16, 2011.

Synthetic cathinones are central nervous system stimulants, typically ingested, inhaled, injected, smoked, or snorted to produce effects similar to those of amphetamine abuse. Symptoms can include increased heart rate, agitation, hallucinations, extreme paranoia, and delusions as well as chest pain, vomiting, and suicidal thoughts.

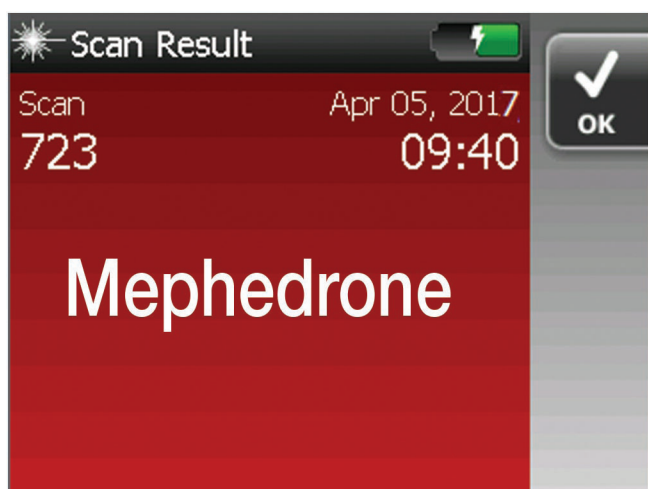
The Thermo Scientific TruNarc analyzer (see Figure 1) is a handheld Raman spectrometer designed to meet the needs of the law enforcement community. It includes an extensive on-board library of narcotics, cuttings agents, and precursors to allow rapid, precise analysis. The device collects the molecular fingerprint of an unknown sample, and then compares the substance against the library using sophisticated chemometric algorithms to deliver easy to interpret results in a matter of seconds. (See Figure 2.) Raman instruments excel at identifying liquids, gels, pastes, and light-colored solid materials, including tablets and the contents of capsules.

Sample cathinones and their unique spectral fingerprints are plotted in Figure 3. The TruNarc™ library includes many different synthetic cathinones, enabling the rapid screening of these narcotic threats.

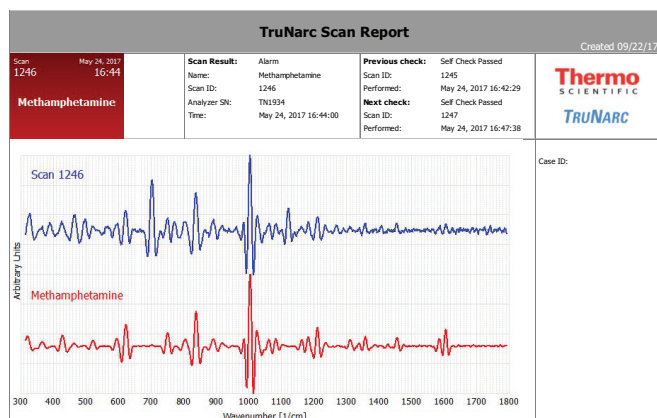
**Figure 1. The TruNarc analyzer scans through sealed packaging to minimize exposure and reduce contamination risk.**







**Figure 2.** The TruNarc analyzer provides clear identification results which require no user interpretation.



**Figure 3.** Several Raman spectra of cathinones (and their common names)

## Legal Update

**Australia:** April 2011, methcathinones and other cathinone derivatives were added to Australian Federal Police controlled substance list.

**China:** Cathinone and methcathinone have been controlled substances based on Chinese State Food and Drugs Administration (SFDA) regulations since 2007; in 2010, mephedrone was added to the list of controlled substances.

**Europe:** Mephedrone and other cathinone derivatives are now banned in all member states of the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA).

**United Kingdom:** April 2010, mephedrone, flephedrone, methylone, and butylone were added to the Misuse of Drugs Act of 1971.

**United States:** October 2011, mephedrone, methylone, and MDPV were added to U.S. DEA Controlled Substances Act.

## Summary

Synthetic cathinones represent a tremendous health risk worldwide and their explosive growth has shown no signs of slowing. The impact is compounded by intentional mislabeling designed to avoid sales restrictions and prosecution. The rapid evolution of the drugs adds further challenge because they are not detectable using common field test kits, canines, or routine drug screens.

The TruNarc analyzer enables law enforcement personnel to quickly identify multiple suspected drugs – including synthetic cathinones – in one single test. It leverages widelyaccepted Raman spectroscopy in a compact, handheld instrument to identify numerous drugs of abuse including narcotics, stimulants, depressants, hallucinogens, and analgesics.

For more information about cathinone identification with the TruNarc analyzer, please contact:

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## References:

- American Association of Poison Control Centers, "Bath Salts Data," October 2011.
- Drug Enforcement Administration, Office of Diversion Control, Drug & Chemical Evaluation Section, "3,4-Methylenedioxypyrovalerone (MDPV)," October 2011.
- New Jersey Office of Consumer Affairs, Division of Consumer Affairs, "Designer Drugs Labeled as 'Bath Salts': Facts About Synthetic Cathinones," April 28, 2011.
- U.S. Department of Justice National Drug Intelligence Center, "Situation Report/Synthetic Cathinones (Bath Salts): An Emerging Domestic Threat," Product Number 2011-S0787-004, July 2011.
- Goodnough, Abby and Katie Zezima, "An Alarming New Stimulant, Legal in Many States," The New York Times, July 16, 2011, <http://www.nytimes.com/2011/07/17/us/17salts.html?pagewanted=all>
- Walsh, James, "Cops just can't keep up with latest designer-drug threats," The Star Tribune, November 21, 2011, <http://www.startribune.com/local/134183833.html>.
- Matthews, Allison and Raimondo Bruno, "Mephedrone use among regular ecstasy consumers in Australia," ecstasy and related drug trends bulletin, December 2010. Archived from the original on 2011-02-18. [www.webcitation.org/5wZFYyEx7](http://www.webcitation.org/5wZFYyEx7).
- European Monitoring Centre for Drugs and Drug Addiction "Europol-EMCDDA Joint Report on a new psychoactive substance: 4-methylmethcathinone (mephedrone)," March 2010
- Power, Mike, "Orient Express, How mephedrone shook the drug world – World Wired Web". Druglink. DrugScope. January/February 2010: 11–13. [www.drugscope.org.uk/Resources/Drugscope/Documents/PDF/Good%20Practice/DruglinkJanFeb10.pdf](http://www.drugscope.org.uk/Resources/Drugscope/Documents/PDF/Good%20Practice/DruglinkJanFeb10.pdf)
- U.S. Department of Justice, Drug Enforcement Administration, Microgram Bulletin, "4-Methylmethcathinone in Oregon," 42, no. 7(July 2009): 61.

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