B189 Investigating the Use of Illicit Drug Smoke Aerosol Residues as Recoverable Trace Evidence

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After attending this presentation, attendees will understand how aerosol residues may provide a valuable form of forensic evidence in drug-related cases that is currently unused.

This presentation will impact the forensic science community by providing the first results of examining third-hand smoke aerosol residues from drug substances other than tobacco cigarettes. This presentation will add to criminalistics and trace evidence research by exploring the potential for expanding the types of drug evidence recovered from scenes when the contraband is not present.

Smoke aerosol residues, or third-hand smoke, from tobacco cigarettes has been highlighted in recent years as a silent and significant threat to the health and safety of indoor environments. These residues are the remnants of second-hand smoke that are deposited onto surfaces such as clothing, car interiors, countertops, tables, and chairs. Studies have demonstrated that these smoke residues and their degradation products on various interior surfaces can be collected and identified in areas of habitual smoking. Where these findings are especially important for health concerns, the studies performed with nicotine and other cigarette smoke alkaloids lend themselves to an untapped source of trace forensic evidence.

In this experiment, three commonly smoked illicit drugs were chosen and examined for their potential as recoverable smoke aerosols from idealized surfaces. Cocaine, heroin, and methamphetamine were made into useable standard solutions and a known mass was deposited onto a substrate and dried for 24 hours. These substrates were heated at various temperatures to volatilize the drug into a vapor and the resulting aerosol was collected either passively or under the influence of suctioning air flow onto a silicon wafer collector surface. The size of the aerosol particles was investigated using particle measurement instruments and the collection substrates were analyzed via electron microscopy to examine the physical state of the aerosol particles. Chemical analysis was performed using high-performance liquid chromatography, electrospray ionization/mass spectrometry, and direct analysis in real-time mass spectrometry to investigate the extent of pyrolytic degradation of each drug as a function of temperature. Experiments were also performed by introducing adulterant or substances in combination with the illicit drug to understand how impure street samples may undergo different volatization processes.

Particle size measurements showed that greater than 90% of the aerosols generated were 1µm or less in size for both illicit and adulterant drugs examined. A trend toward smaller particle sizes was also seen with increasing temperature; however, a slightly larger average size was seen when an illicit drug was mixed with an adulterant. The increase in temperature also increased the concentration of degradation products formed from pyrolysis of the drugs, beginning around 400°C for most drugs examined.

This study examines the first steps toward the recovery of useful forensic evidence in drug-related offenses without having to have a drug sample, or even visible drug particles, present. Future work will expand on the current study pertaining to the illicit drugs studied and various combinations as well as recovery from surfaces encountered in buildings and vehicles and environmental effects.

Illicit Drugs, Residue, Aerosol