A31 Fast Forensic Analysis of Methamphetamine and its Enantiomers Using Ion Mobility Spectrometry

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After attending this presentation, attendees will learn of a novel analytical method, Chiral Ion Mobility Spectrometry (CIMS), for the separation of enantiomers found in amphetamine type substances (ATS). The technique will introduce, for the first time, the separation of enantiomers found in methamphetamine and could open the possibility of utilizing the data obtained in determining the provenance of seized drugs.

This presentation will impact the forensic science community by helping to determine sources of supply, drug trafficking routes, and connections between different seized batches of drugs. The cost of conducting chiral separations has previously made this technique impractical in routine analysis. However, CIMS serves to alleviate this cost barrier by providing a high speed and low cost analytical technique with results comparable to that obtained from previously established and more expensive chiral separation techniques.

Chiral Separations have long since been a challenging aspect of analytical chemistry. There currently exists thousands of chiral separation phases predominantly used in liquid chromatography, gas chromatography, and capillary electrophoretic assays. The chiral phases themselves are expensive while the time and resources required in selecting the appropriate phase for a particular enantiomer is another prohibitive factor. Second only to Cannabis, ATS are the most widely abused illicit drugs in the world to date. Nearly all ATS are optically active and, as such, exist as enantiomers. Abused ATS are synthesized from precursor compounds that are often found in the end product. These impurities from the manufacturing process vary widely, depending on the kind of drug being manufactured and the steps taken during purification. For Methamphetamine, common precursors are ephedrine and pseudoephedrine, both being chiral in nature. The ability to detect and ultimately separate these enantiomers as impurities in seized drugs has been proven in previous studies and has also been used to determine provenance leading to connections between seizures by utilizing capillary electrophoresis with UV detection and GC-MS analysis.

Chiral IMS, much like drift tube IMS, relies upon separation of charged species under atmospheric pressure as they move through an applied electric field while under the mild interaction of a counter- flowing chiral modifier. Steps taken in introducing the chiral modifier and the variations in resolving power will be displayed. The easy “on the fly” setup will also show the creation of a dual mode separation system that is able to conduct non-chiral drift tube separations for rapid screening and identification of unknown substances and then, through the touch of a button, the system becomes chiral to conduct enantiomeric separations.

Results obtained to date have identified an IMS counter flow gas that may be used to effect separation of ephedrine and pseudoephedrine enantiomers, which are currently indistinguishable by using standard GC- MS techniques. This first reporting of a CIMS separation will be used as a stepping-stone in developing techniques that rely upon previously ignored chiral data within the forensic arena.

This presentation will ultimately demonstrate the capabilities of CIMS, through the conversion of a standard commercially available drift tube IMS system to separate enantiomers of ATS, namely ephedrine and pseudoephedrine. The results of the study will be discussed and compared with similar data obtained from other techniques. The development of a high speed, low cost chiral separation system will become a valuable forensic tool for the analysis of ATS and enantiomers and could lead to provenancing of illicit drugs of abuse.

Enantiomer, Chiral, Ion Mobility Spectrometry

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