IntoxiSense: Next-Generation Substance Identification and Cognitive Impairment Detection



Advancing Safety with Near-Infrared Spectroscopy Thursday 12 June 2025

Reliable substance detection and cognitive impairment assessment are fundamental in law enforcement, workplace safety, and forensic toxicology. IntoxiSense by MKPro is a cutting-edge commercial solution that leverages Near-Infrared (NIR) Spectroscopy to provide accurate and non-invasive detection of alcohol, illicit substances, and their metabolites.

Ion Mobility Spectrometry (IMS) has long been used in forensic investigations, but false positives, environmental instability, and inconsistent concentration estimations limit its effectiveness. IntoxiSense solves these challenges using molecular vibrational fingerprinting, and spectral correlation techniques combined with advanced signal processing methods, ensuring high-precision detection and real-time impairment analysis.

This white paper explores the scientific foundation, technological advancements, and commercial applications of IntoxiSense, illustrating its role in transforming roadside screening, workplace risk management, and forensic toxicology practices.

Scientific Foundations: Why NIR Spectroscopy is Superior

Accurate substance identification relies on detecting molecular structures with high specificity while minimising environmental and instrumental variability. IntoxiSense deploys NIR spectroscopy to achieve this by analysing infrared absorption bands associated with molecular vibrations, ensuring reliable classification of alcohol and drugs across varied sample conditions.

Spectral Absorption and Molecular Vibrational Fingerprinting

NIR spectroscopy operates in the 780–2500 nm wavelength range, measuring the vibrational transitions of molecular bonds, including C-H, O-H, and N-H functional groups. These spectral fingerprints enable precise differentiation between chemically similar substances, eliminating misidentifications caused by overlapping ion mobility profiles in IMS. Distinct near-infrared absorption bands provide critical molecular insights, with the 1200 nm range refining alcohol detection, the 1400–1900 nm window capturing nitrogen-containing structures for pharmaceutical analysis, and the broader 1700–2500 nm spectrum aiding in complex compound classification, including psychoactive substances.

Addressing IMS's Limitations with Advanced Spectral Normalisation

IMS detects substances based on ion mobility profiles, relying on external ionisation conditions that vary with temperature, humidity, and sample composition. These factors contribute to false positives, especially in forensic and workplace applications.

By contrast, IntoxiSense integrates advanced spectral analysis to enhance precision and reliability, overcoming challenges such as instrument drift and sample variability. Through sophisticated comparative modelling, it ensures consistent identification across diverse real-world conditions. Additionally, refined signal processing techniques isolate critical molecular signatures, further elevating classification accuracy. By filtering background interference, IntoxiSense refines spectral patterns for high-confidence substance classification, distinguishing low-concentration alcohol levels from water, or detecting drug metabolites with enhanced precision with legally defensible screening backed by validated spectral analysis.

Commercial Applications: Deploying IntoxiSense Across Industries



- Law Enforcement & Roadside Screening
- Instantaneous alcohol and drug identification for traffic safety
- Non-invasive cognitive impairment assessment for roadside enforcement

Workplace Safety & Occupational Risk Management

- Reliable impairment detection for machinery operators and transport drivers
- Substance influence assessment for workplace compliance
- Supports employers in reducing liability through validated impairment metrics

Forensic Toxicology & Pharmaceutical Analysis

- High-accuracy detection of illicit substances, including emerging drugs
- Quantitative substance concentration estimation for toxicology reports
- Real-time forensic validation for law enforcement and regulatory agencies

Why IntoxiSense is the Future of Substance Detection

IntoxiSense represents a paradigm shift in forensic science, workplace safety, and impairment assessment technologies. Unlike traditional detection tools, IntoxiSense offers:

- Unmatched specificity using NIR spectral fingerprinting
- Non-invasive, rapid detection with legally defensible results
- Portable, scalable solutions for real-time deployment
- Comprehensive commercial applications across multiple industries

IntoxiSense pioneers a new standard in safety, accuracy, and efficiency—delivering groundbreaking reliability in substance identification and impairment assessment.

Conclusion

The adoption of NIR Spectroscopy marks a significant advancement in forensic toxicology and substance detection. IntoxiSense eliminates inaccuracies, offering validated, high-precision results through spectral fingerprinting, and frequency-domain-pattern-analysis using mathematical transformations enhancement techniques.

With market-ready deployment across law enforcement, workplace safety, and forensic sciences, IntoxiSense delivers revolutionary impact in substance detection and impairment assessment.

For further enquiries or implementation strategies, contact **MKPro** today.

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