Flexible PCB-based Drift Tube for Ion Mobility and Hyphenated Spectrometry

A bespoke and stand-alone DT IMS with improved ruggedness, noise immunity and manufacturability while reducing size, weight and cost

Reference: PCB Drift Tube

IP Status

Patent application submitted

Seeking

Commercial partner, Development partner, Licensing

About University of Liverpool

By facilitating access to our expertise, facilities and networks, the University of Liverpool offers the means to transform ideas into creative solutions, improved performance, new technologies, strategies, applications, products or skills.
Background

Ion mobility spectrometry (IMS) is a versatile analytical tool that allows general-purpose chemical detection and measurement.

This popular technique offers high sensitivity (with detection limits routinely in the part per billion-range) and fast response times of just a few seconds. IMS is routinely used for a wide range of applications, including detection of contaminants in the pharmaceutical industry, in law enforcement for the detection of narcotics and is well known for its deployment by border agencies (e.g., aviation) and for military purposes to detect explosives and chemical weapons.

The most common IMS technique relies on a drift tube (DT), which is the 'heart' of the instrument. Current state-of-the-art DTs require stacked alternating electrode and insulator designs. These have a number of drawbacks, in particular high manufacturing and assembly cost. Research advancements have led Liverpool researchers to rethink this technology to make it more versatile, cheaper and ultimately able to reach a broader market.

Tech Overview

The University of Liverpool has developed a bespoke and stand-alone DT IMS with improved ruggedness, noise immunity and manufacturability while reducing size, weight, power requirements and cost. This approach relies on flex-electronics techniques to produce a DT which is amenable for mass-production.

Further information:

Figure 1 - CAD illustration of the flexible drift tube prior to rolling; the insert magnifies our novel 'dog-leg' arrangement. (b) Simple coiling process. (c) Section view of coiled up drift tube.

Figure 2 - Electric field comparison of Flexible-DT-IMS versus the standard approach (stacked ring design) and a state of the art ("resistive") construction.

Figure 3 - Example construction of a Flex-DT incorporated in to an early stage prototype IMS system.

Figure 4 - Exemplar IMS spectra for some common explosives from a prototype Flex-DT-IMS system using two different ionisation strategies.

Applications

This technology has recently experienced a boom in application studies, ranging from air pollution monitoring to breath analysis for cancer detection. It also has significant potential to replace more expensive and cumbersome lab equipment, particularly in developing countries as it is inherently rugged and capable of front line analysis.
Besides military, security and some other niche application areas, this technology has yet to reach broader use. One of the drawbacks of this technology is its high unit cost. Whilst conceptually the hardware is simple, commercial units typically range in price between ~$50,000 to $100,000+ USD.

The Liverpool researchers' technical innovation has enabled a significant reduction in the fabrication and labour costs per unit which can potentially open up new market opportunities. Whilst the researchers have the possibility and know-how to develop a range of technical solutions for tailored niche applications, there is potential to increase volume.

Patents

- WO 2019 175604A1
Appendix 1

Figure 1

CAD illustration of the flexible drift tube prior to rolling; the insert magnifies our novel 'dog-leg' arrangement. (b) Simple coiling process. (c) Section view of coiled up drift tube.
Appendix 2

Figure 2

Electric field comparison of Flexible-DT-IMS versus the standard approach (stacked ring design) and a state of the art (“resistive”) construction.
Example construction of a Flex-DT incorporated in to an early stage prototype IMS system.
Figure 4

Exemplar IMS spectra for some common explosives from a prototype Flex-DT-IMS system using two different ionisation strategies.