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News and Views

Recent Developments in Gas Chromatography-Mass Spectrometry

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A desire for miniaturization, flexibility, and faster results is the current global trend. Increase in the number of samples as well as regulatory requirements demands a focus on targeted and non-targeted molecules in the areas of food safety and environmental health. Data handling solutions which are user friendly combined with smart instruments are helpful in preventive maintenance, ownership cost reduction, and simplifying workflows. Functions, such as automatic leak checks and troubleshooting diagnostics, allow operators to achieve better results faster, with fewer mistakes. Guiding users through preventative maintenance steps helps reduce sample reruns and unplanned downtime, greatly improving productivity. Remote connectivity is a future trend as digital transformation sweeps across analytical laboratory enterprises worldwide, driving resource deployment optimization. Remote connectivity and smart functionality are also invaluable when laboratory access is limited. Green chemistry and sustainable operations are also clear trends, and many new instruments are being designed to use less power, water, helium, and other natural resources. Use of cost-efficient, oil-free Gas Chromatography-Mass Spectrometry is increasing. Another growing trend is moving applications to smaller, greener, and faster Gas Chromatographic systems with efficient direct heating technology. There is an increase in discovery-based approaches, where workflows that are typically seen in the "omics" fields are now expanding to other application areas. Recent trends in Gas Chromatography hyphenated with Mass Spectrometry include an increase in the use of triple quadrupole instruments, instrument miniaturization, and the migration towards multiclass methods of analysis. Detector sensitivity is outpacing analytical column and instrument designs in some cases, which should prompt further research. The need for faster analysis and miniaturization is increasing the demand for chips technology or low thermal mass systems together with new micro-detectors and mass spectrometers. Portable GC-MS with on-field sampling techniques brings immediate results in fields such as air pollution or soil analysis. To characterize advanced materials and microplastics, we observe a global trend towards hyphenated technologies, such as thermal gravimetry combined with infrared (IR) and GC–MS. This approach brings more information-rich data in a single run. The future will see more and more GC systems coupled to mass spectrometers especially for food and environmental applications. Triple quadrupole GC-MS will be deployed more often. Micro-GC will continue to be valued for its convenient small form factor, rapid cycle times and its ability to verify calorific value as a measure of quality and economic valuation. The future of GC-MS will continue to focus on reduced analysis times, increased sensitivity, and platform miniaturization. MS will continue to increase in sensitivity, such as lower detection limits, through more efficient generation and transfer of ions. Instrument uptime will be maximized through the development of more rugged surface chemistries and easily replaceable guard assemblies. Greater adoption of tandem mass detectors will also grow as their footprint and price continues to drop. The future of GC-MS may be uncertain with the potential adoption of ambient/atmospheric pressure ion sources such as desorption atmospheric pressure photoionization, desorption electrospray ionization, and/or direct analysis in real time. These ionization techniques are currently applied without the use of a GC system and it's unclear as to whether or not these techniques will be incorporated with the use of a GC or eliminates the need for a GC system. Until that time, instrument manufacturers will continue to innovate in all the aforementioned areas. Air and water quality continue to be recognized as critical, not only to human health, but also to the health of the planet as a whole. This is driving GC-MS demand in air and water monitoring, and also in food quality due to globalization. Furthermore, pharmaceutical companies have invested a lot in production plants and require routine QA/QC systems under GMP-regulated environments. Cannabis and hemp markets also continue to be a growth enhancer for GC-MS. The growing legalization of cannabis worldwide is driving rapid demand for purity and potency analysis. The demand for GC-MS Triple Quad is growing rapidly as it is a popular technique to determine pesticides in plant materials. Fully automated sample handling devices or high-throughput systems are also in high demand. GC-MS systems are being accepted as an important tool globally as a result of their more specific and sensitive detection capabilities and simplified use. The increasing complexity of materials needing to be analyzed GC-MS is a real challenge to technology and

instrument development. However, the growing use of MS/MS techniques greatly simplifies data for complex mixtures, improving specificity and certainty. There is also a need to develop GC-MS technology that is fully compatible with a hydrogen carrier.

REFERENCES

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