Liquid Chromatography Problem Solving and Troubleshooting

Question:

I know that this is not the usual type of troubleshooting question. However, I am confused about a type of universal high-performance liquid chromatographic detector called an evaporative mass detector. What is it, and how does it work?

Answer:

I believe you are referring to what is more commonly called an evaporative light scattering detector (ELSD), which has been available for some time; currently, I know of three commercial brands, and there may be more. Unfortunately, these detectors have been referred to in the literature, advertisements, and various marketing presentations as "evaporative mass detectors", "mass detectors", "laser light scattering detectors", and "light scattering detectors". These terms, although not quite accurate, are not incorrect; as a result, these terms cause confusion with other established techniques such as low angle laser light scattering detectors and mass spectrometers.

The ELSD is a useful detector, but it should be emphasized from outset that the ELSD does not respond to mass as a flame-ionization detector does, nor is it able to discriminate molecular weights as a mass spectrometer does. The laser is used as an intense light source; it is not useful in molecular weight characterization as the low angle laser light scattering detector is.

Figure 1 is a typical ELSD schematic. The effluent from the HPLC is combined with a gas flowing at about 5 L/min in a nebulizer to form a fine, misty spray of droplets which enters a heated evaporator tube. Assisted by an exhaust system, the droplets are quickly swept through the heated tube where the solvent is evaporated, leaving behind small particles of sample that travel through the detection chamber. In the chamber, the particles pass through a beam of light causing some of the light to be scattered and detected by a photomultiplier tube. The light scattering effect is the same as that observed when viewing dust in a strong shaft of sunlight.

In theory, an ELSD will respond to any nonvolatile analyte. If your analyte is volatile, no signal will result. In principle, any volatile solvent can be used provided the solvent does not contain buffers or other nonvolatile components that would result in unacceptably high background signal. Using the ELSD in gradient elution is possible, and it may also be possible to detect analytes that otherwise could not be detected with ultraviolet (no chromaphore) or refractive index detectors.

In practice, the ELSD does have some limitations. The detector does not have equal response for equal masses of analytes; thus, it does not respond to true mass. The response is dependent upon the number, size, and shape of the analyte particles, and these parameters may vary for a given mass of each analyte. In addition, response depends upon operating parameters such as the flow rate and type of gas, the evaporator tube temperature, and the chemical nature of the analyte. It has also been shown that the response of the detector is nonlinear (1), which means the system must be calibrated for each analyte. But, given the drawbacks, it is still a useful means of detecting compounds that otherwise are not easily detected by the more common HPLC detectors.

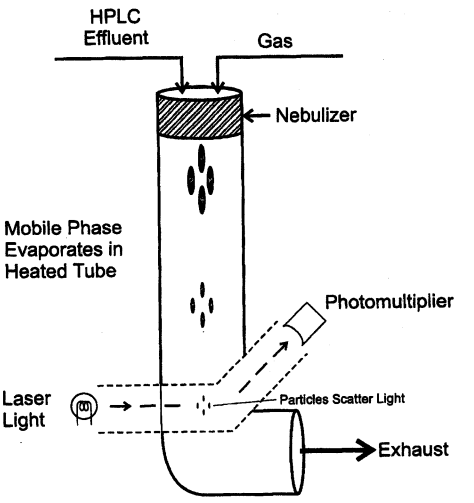

Figure 1. Schematic of an evaporative light scattering detector.

Reference

1. G. Guiochon, A. Moysan, and C. Holley. *J. Liq. Chromatogr.* **11:** 2547–70 (1988)

The purpose of *Chromatography Problem Solving and Troubleshooting* is to have selected experts answer chromatographic questions in any of the various separation fields (GC, GC–MS, HPLC, TLC, SFC, HPTLC, open column, etc.). If you have questions or problems that you would like answered, please forward these to the *Journal* editorial office with all pertinent details: instrument operating conditions, temperatures, pressures, columns, support materials, liquid phases, carrier gas, mobile phases, detectors, example chromatograms, etc. In addition, if you would like to share your expertise or experience in the form of a particular question accompanied by the answer, please forward to JCS Associate Editor, *Chromatography Problem Solving and Troubleshooting,* P.O. Box 48312, Niles, IL 60714. All questions/answers are reviewed to ensure completeness. The *Journal* reserves the right not to publish submitted questions/answers.

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