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Thin-Layer Chromatography Coupled with Mass Spectrometry

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I. INTRODUCTION

The overall performance of a separation method is intrinsically linked to the performance of the detector used as part of the system. Other handbook chapters detail principles, operation, and applications of common detectors for thin-layer chromatography (TLC), many of which have been in use since the beginnings of TLC. In contrast, mass spectrometry (MS), especially in an imaging mode, is a relatively new detection method for TLC. Mass spectrometry has been used with gas chromatography and liquid chromatography, and with supercritical fluid chromatography and capillary electrophoresis, to provide a balanced combination of separation and detection capabilities. Benchtop GC/MS systems (available for about $50,000 USD) are operated directly by the end user. Other low-cost, high-performance chromatography/mass spectrometric combinations will follow with continued development of a new generation of smaller, more automated mass spectrometers. These same technological developments have also led to TLC/MS in several different forms. Moreover, renewed emphasis on the measurement of two-dimensional imaging data from mass spectrometry holds genuine promise for TLC/MS and for planar chromatography coupled with mass spectrometry in general. This chapter summarizes the approaches that have characterized TLC/MS since its first inception through to the more recent one- and two-dimensional imaging systems.

Commercial analytical instruments are developed when manufacturers perceive that a profit can be derived from meeting the demand of the marketplace. Demand in the marketplace develops when consumers are convinced of the practical value of the instrument in the solution of problems at hand and when an instrument is readily available and supported by the manufacturer. Demonstrations of feasibility are the break in this circular conundrum. Over the past 15 years, TLC/MS has been shown to be technically feasible and applicable to a wide variety of problems in both qualitative and quantitative analysis. Commercial interest in TLC/MS, however, is still limited. The same path of development was followed for TLC coupled with infrared spectrometry.

TLC/MS is only part of the more general area of planar chromatography coupled with mass spectrometry (PC/MS). However, applications and research that involve mass spectrometry as a detector for planar chromatography continue to emphasize thin-layer chromatography. TLC, in classical and high-performance formats, is widely used in analytical laboratories around the world, and the advantages of the additional specificity derived from the mass spectrometric detection have been evident for some time, as covered in previous reviews. The most relevant analytical points for PC/MS and TLC/MS are identical.

Although feasibility has been demonstrated and the instrument technology is in place, TLC/MS is still not offered as a stand-alone instrument within the commercial marketplace. The MS market itself has changed significantly over the past five years. Fewer general-purpose mass