Two-dimensional chromatography. Foreword

We initiated this special issue on Comprehensive two-dimensional chromatography to bring together contemporary high-level research in this field. Our objectives were to present a representative perspective on the state of the art, to highlight trends in applications and instrumentation, and to identify eventual shortcomings or specific targets for further evolution of the technology. We had quite a good response to our call for papers. Most contributions focused on comprehensive two-dimensional gas chromatography (GC $\times$ GC) and a much smaller number on comprehensive two-dimensional liquid chromatography (LC $\times$ LC). This is remarkable, because Journal of Chromatography A publishes many more papers on liquid-phase separations than on gas chromatography. Several reasons may be identified for the large number of GC $\times$ GC papers in this volume. The technique is now well established as an invaluable tool for the separation of complex mixtures of volatile analytes. The technology and instrumentation are reaching maturity, but several contributions in this volume indicate that improvements are still being sought. The strengths of GC $\times$ GC are now being demonstrated by applications on challenging samples, as is evident from the contributions in this volume. Potentially, there is an even greater need for LC $\times$ LC, because the vast majority of highly complex samples do not exclusively contain volatile analytes. Also, one-dimensional LC separations are typically less powerful (fewer theoretical plates, longer analysis times) than one-dimensional GC separations and LC still suffers from a lack of near-perfect detectors (highly sensitive, nearly universal, linear across a broad dynamic range). GC-MS is a robust and reliable technique with sufficient fragmentation and reproducibility to yield searchable spectra. LC-MS is more limited and not applicable to all non-volatile analytes and LC-MS/MS is usually required for reliable identification and quantification. However, LC $\times$ LC is not nearly as mature as is GC $\times$ GC. There are issues with mobile-phase compatibility and detection sensitivity and developing LC $\times$ LC methods is a great challenge. Many LC $\times$ LC papers still focus on fundamental and technical aspects, but significant progress has been made in recent years and good instrumentation has become available from several manufacturers. The development of LC $\times$ LC may be a decade or so behind that of GC $\times$ GC, but the technique will find many more relevant applications in years to come. A variety of application fields are covered in this volume. Arguably, the oil and petrochemical fields have spurred the development of first GC and later GC $\times$ GC. Still, energy-related applications form one of the most important application areas covered in this volume. Food is the second most-important application field. Food samples tend to be extremely complex and the questions facing analytical chemists often require advanced separation techniques, including GC $\times$ GC and LC $\times$ LC, usually in combination with mass spectrometry. Other areas of application addressed in this volume include environmental science, forensics and herbal medicines. This special volume on Comprehensive two-dimensional chromatography does not cover all aspects of the field in great detail, but it does provide a very informative snapshot of the current status of an exciting field that will see further innovation and successful application in years to come.

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