On-Chip Liquid Chromatography

Subjects: Others
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On-chip liquid chromatography (LC) refers to LC technology that is miniaturized to fit on a microchip to enable fast, high-throughput analysis, with small sample volumes and low reagent consumption. Four different on-chip LC approaches have been developed to date: use of open-tubular, packed-particle, monolithic, and pillar array columns. These methods have been applied to proteomics as well as the analysis of small molecules and drugs in various biological samples. Recent advances in on-chip LC are summarized herein.

Keywords: micro total analysis system ; open tubular ; packed particle ; monolithic ; pillar array

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Liquid chromatography (LC) is an indispensable separation technique with many biological, clinical, environmental, forensic, and pharmaceutical applications. Various stationary phases can be used for LC, and this technique provides highly reproducible results. In omics research, such as proteomics and metabolomics, LC coupled to mass spectrometry (LC-MS) is an effective analytical method for highly sensitive and accurate mass determination. However, it is still difficult to achieve satisfactory separation, particularly in complex mixtures such as biological samples (tissue, plasma, serum, and urine). In metabolomics, thousands of metabolites must be measured simultaneously. Furthermore, some important biological compounds are present only in small amounts, along with high concentrations of other endogenous compounds that may present interference. These challenges can be overcome through LC miniaturization.

In recent years, micro total analysis systems (microTAS), also known as lab-on-a-chip, have emerged as an attractive area of research. In a microTAS, sampling, sample transport, necessary chemical reactions, separation, and detection are all performed on a chip. Separation is one of the key processes in a microTAS. Therefore, extensive research has been conducted to realize on-chip separation using miniaturized LC.

Previous studies have examined on-chip separation using electrophoresis or electrochromatography. However, there are relatively few examples of chip-based LC. Four different on-chip LC approaches have been developed to date: use of open-tubular, packed-particle, monolithic, and pillar array columns (**Figure 1**). These techniques enable fast analysis, while offering the advantages of high throughput, very small sample volumes, and low reagent consumption. Each method is described in the following section.

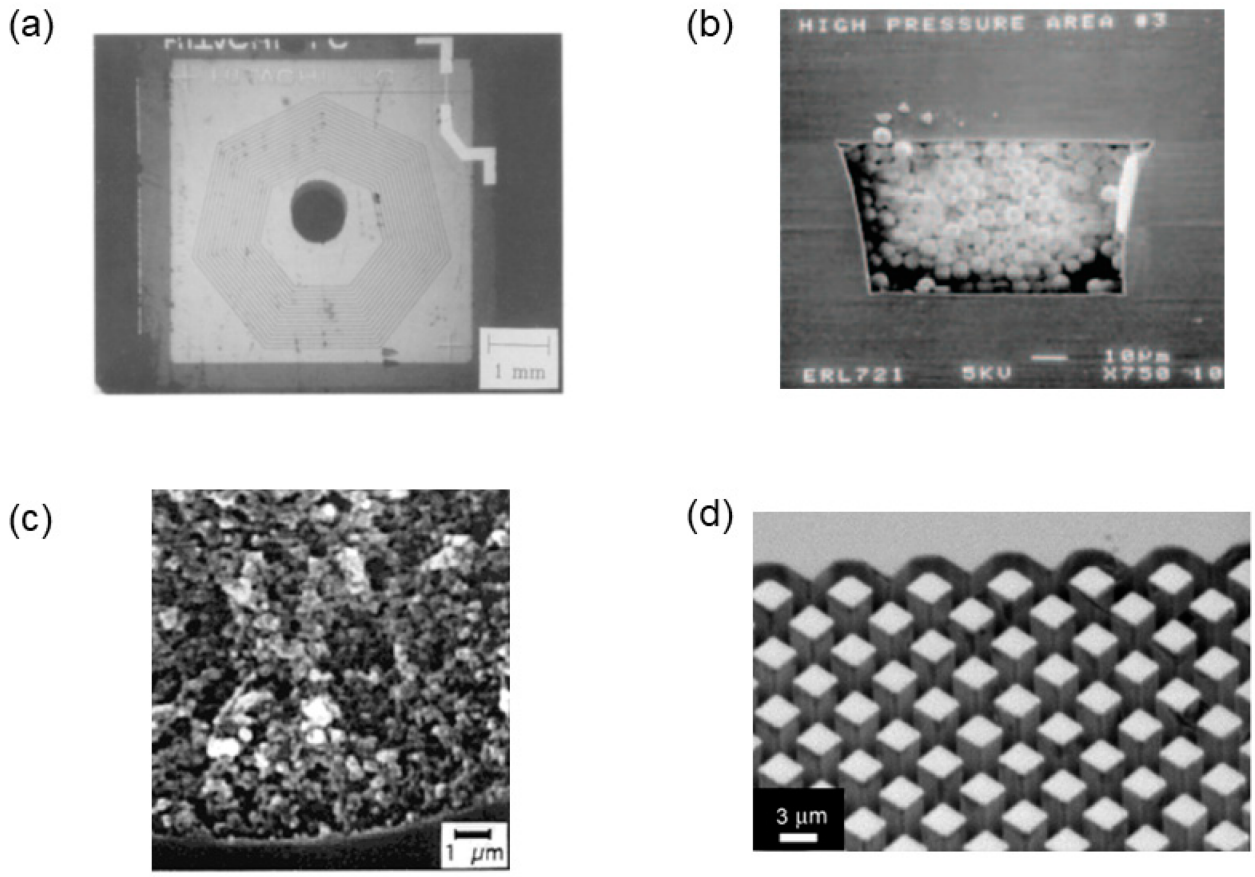

Figure 1. Four approaches for on-chip LC: use of (**a**) open-tubular [1], (**b**) packed-particle [2], (**c**) monolithic [3], and (**d**) pillar array columns [4]. Reproduced with permission from references.

References

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