Flow-based Analytical Techniques

Yasutada SUZUKI

Faculty of Life and Environmental Sciences, Graduate Faculty of Interdisciplinary Research, University of Yamanashi, 4-4-37 Takeda, Kofu, Yamanashi 400-8510, Japan

Flow-injection analysis (FIA) was invented by Šužićka and Hansen. Flow-based analytical techniques, including sequential-injection analysis (SIA), is widely used in various fields, such as process control, environmental, clinical, pharmaceutical, food analysis, and so on. Several types of detectors are used in flow analytical systems, of which chemiluminescence (CL) is one of the most sensitive detection methods. Hasanin et al. reported on the determination of antimony(III) and (V) using a reversed micelle system of diperiodatoargentate(III) (Ag(HIO₆)₂)₅⁻ as oxidizing agents, extraction and phase separation. A detection limit was attained by using a reversed micelle system of rhodamine B-ethyltrimethylammonium chloride and online extraction and phase separation. A detection limit was attained as low as 0.35 μmol dm⁻³. Yaqoob’s group reported FIA-CL methods for the determination of thiabendazole, and hyoscine butylbromide, using diperiodatocuprate(III) (Cu(HIO₆)₂)₅⁻ and diperiodatoargentate(III) (Ag(HIO₆)₂)₅⁻ as oxidizing agents, respectively. Miyamoto et al. has developed an evaluation method for hydroxyl radical (·OH) scavenging activities with CL detection. The system uses the Fenton reaction, which produces CL by a reaction between luminol and ·OH; the diminution rate of the CL is used to evaluate the scavenging activity. SIA technique is utilized to automate all of the reactions. Electrochemical detection is another sensitive method for flow-based analysis. Matsuura et al. reported on how tightly immobilized electrodeposited platinum particles on nitrogen-containing functional groups introduced glassy carbon, and its application to the determination of dissolved hydrogen molecules. Since SIA does not require a constant monotonous flow of a carrier or reagent solution, it can reduce their consumption compared to FIA. SIRIANGKHAWUT et al. reported on SIA for aluminum determination using natural chelating reagent extracts from a heartwood of Ceasalpinia sappan Linn. to establish a more eco-friendly method. Thaithet et al. reported on sequential injection chromatography (SIC) using an ultra-short monolithic column for the separation of α-tocopherol and γ-oryzanol in edible oils and nutrition supplements. The total analysis time, including column equilibration, is 16 min, and the obtained results agree well with the results from HPLC. At first, the application of SIC was limited to the determination of pharmaceutical samples; now it has been expanded to various samples, such as biological, food, and environmental analyses.

Flow- or sequential-injection techniques can be used to preconcentrate analytes for atomic spectrometry. Tiwari et al. reported on the use of a minicolumn packed with Amberlite XAD-16 with a flow-injection technique for the online preconcentration of chromium and its determination by flame atomic absorption spectrometry. Ayala et al. used a sequential-injection technique with solid-phase extraction for the determination of strontium and nickel by microwave plasma atomic emission spectrometry. A crown ether chromatographic resin and dimethylglyoxime polymethacrylate resin were used for the preconcentration of strontium and nickel, respectively. Sumitomo et al. used an internal standard, the amplitude modulation of flow rates for sample solutions and fast Fourier-transformation signal processing, to determine two different samples simultaneously. A validation of the method was demonstrated by using the determination of iron(II) with 1,10-phenanthroline. The stability of this unique system was improved by an internal standard solution (methylen blue). The development of new applications and flow-systems will be continued for more sensitive and easier determinations.

Keywords Flow-based analytical technique

References