

SUMMARY

By reason of constantly growing urbanization and rapid industry development, modern analytical chemistry has to face challenges regarding reliable determination of environmental, metallurgical and food samples. It is expected that the applied techniques would allow for performing accurate and precise analyses, concurrently reducing the amount of time and costs that are essential to achieve this goal. Currently applied large-scale instrumentation such as graphite furnace atomic absorption spectrometry (GF AAS) or inductively coupled plasma optical emission spectroscopy (ICP OES) allow for reliable determination of many elements at trace and ultratrace levels, however, the application of the aforesaid techniques entails some inconveniences. The most important of such are high costs related to the purchase and utilization of the applied instrumentation, which in an obvious way translates to high unit cost of the analysis. Moreover, due to bulky nature of such devices, those techniques cannot be applied *in-situ* and the analysis of samples with complex matrix requires hours-long sample preparation. The both factors significantly prolong the time required for the analysis execution.

Accordingly, currently, the advance of measurement techniques applied for the elemental analysis is focused on developing new excitation sources that are expected to assure at least similar analytical performance while concurrently fitting into the miniaturization trend that is globally progressing. Therefore, the development of instrumentation that is low enough in size so it could be applied in the real time and place is pursued. This would allow to fully exclude or at least to confine to the bare minimum the steps of collecting and preserving (usually by acidification) samples as well as transporting them to the laboratory. This would consequently lead to limiting the usage of concentrated reagents at the sample preparation stage and reducing the time needed for performing the analysis itself. However, the factor of manufacturing and maintaining the mentioned systems is still important, that is why the proposed systems need to be developed using relatively cheap and easily accessible components, which further translates to the reduction of costs related to performing measurements.

To address the abovementioned issues, the aim of this doctoral thesis was to design and develop miniaturized excitation sources, relied on atmospheric pressure glow discharge generated in contact with overflowing analyzed solutions. At the very beginning, a system design that allowed for the analyzed solution being either a cathode or an anode was proposed. Such construction allowed to apply the newly developed excitation source as two separate systems – flowing liquid anode atmospheric pressure glow discharge (FLA APGD) and flowing liquid cathode atmospheric pressure glow discharge (FLC APGD). Due to this fact, it was possible to apply both mentioned systems for some studies as well as to compare similarities and differences between the two and to assess their potential in the analytical chemistry field. Moreover, the other electrode could be either a metal rod or a gas jet passing through an appropriate metal tube. Such a solution made it possible to fully exclude the application of shielding gas in some cases, which led to lower costs related to the exploitation of the used systems. After the constructing step, the developed systems were coupled to an optical emission spectrometer, acting as the radiation detector. During the research, the design of the developed systems was further modified to achieve the best possible effectiveness of their application.

In the next steps, newly developed systems were applied for elemental analysis. Those analyses were slated in such a way to address the most of the previously known issues related to the application of such excitation sources. That is why, the research, presented in this thesis focused on the improvement of the elements detection, with particular emphasis on elements that are usually hard to determine with fair detectability, the determination of elements that were not previously determined with the aid of such techniques, the modification of the analyzed solutions composition as well as the development of new samples preparation techniques that would allow for significantly reducing the time needed for performing the analysis.