Current trends in trace and ultratrace analysis of liquid samples by X-ray fluorescence spectrometry

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Nowadays, X-ray fluorescence spectrometry (XRF) is a well established analytical technique for elemental analysis of a wide variety of solid samples. In particular, the truly multi-element character, acceptable speed and economy, easy of automation and versatility are the most important features among the many that have made it a very mature analytical tool in many fields. The main drawback of XRF, restricting a more frequent use of this technique, has been its limited elemental sensitivity for the analysis of liquid samples. Nevertheless, recent improvements in XRF instrumentation as well as the development of new sample treatment/preconcentration procedures in combination with XRF systems has expand the analytical capabilities and applications of this technique for the analysis of liquid samples.

Current trends on preconcentration procedures used in combination with XRF spectrometry are focused on the use of liquid-phase microextraction (LPME) procedures, the use of activated thin layers and the employment of nanomaterials (i.e, carbon nanotubes, CNTs) in dispersive micro solid-phase extraction (DMSPE) systems.

It is important to remark the versatility of this kind of preconcentration strategies. Depending of the complexing agent or extracant used in the LPME method, the activated thin layer or the DMSPE procedure using CNTs, we can obtain single-element or multi-element information. Therefore, the user can design the suitable preconcentration method depending on the purpose of the analysis. Another advantage of these analytical strategies is the high improvement of the sensitivity compared with the direct analysis of the liquid sample by XRF spectrometry. Selected examples of this fact are displayed in Figure 1. As it is shown, in addition to an increase of sensitivity, a reduction of the background is also achieved leading to a significant improvement of detection limits. Finally, but not least important, is the low consumption of reagents related with these preconcentration procedures. These systems are included within the framework of the so-called “green analytical chemistry” that is an unquestionable trend in analytical chemistry.

Figure 1. XRF spectra showing the benefits of preconcentration using carbon nanotubes, activated thin layers and liquid-phase microextraction strategies: (A) Activated thin layers for Cd determination at trace levels in sea water samples by HE-P-EDXRF, (B) Carbon nanotubes as preconcentration sorbents for trace elements in water samples by EDXRF, (C) Dispersive liquid-liquid microextraction for trace Cd determination by TXRF.

References