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Analytical measurement in electrothermal atomic absorption spectrometry - How correct is it?

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Abstract

The detection system for atomic absorption spectrometers based on the use of photomultiplier tubes (PMTs) is analysed from the point of view of its ability to provide accurate analytical information. It is shown that absorbance recorded by the system depends not only on the number of absorbing atoms but also on their distribution in the furnace volume. The typical non-uniformity of atomic distribution that occurs in graphite furnaces and its impact on the recorded signal are discussed. The cross-sectional distribution of the intensity of the radiation beam from a primary source was measured at different locations of the spectrometer for different source operating conditions. The distribution is rather non-uniform and can be described by the Gaussian function. An analysis of the joint effect of the radiation and analyte non-uniformity on the absorbance measured is given. The shape of the radiation beam cross-section changes from a circle to an ellipse with increasing lamp current. A new detection system based on the use of a solid-state detector (photodiode array, charge coupled device, charge injection device) instead of PMTs is proposed. The solid-state detector is located vertically along the monochromator exit slit and allows the detection of spatially resolved absorbances. It is shown that the analytical signal recorded by this new system is proportional to the number of absorbing atoms irrespective of the non-uniformities described above.

Keywords

Cross-sectional distribution of radiant intensity and analyte, Electrothermal atomic absorption spectrometry, Spatially resolved detection