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Improved documentation of spectral lines for inductively coupled plasma emission spectrometry

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ABSTRACT

An approach to improving the documentation of weak spectral lines falling near the prominent analytical lines used in inductively coupled plasma optical emission spectrometry (ICP-OES) is described. Measurements of ICP emission spectra in the regions around several hundred prominent lines, using concentrated solutions (up to 1% w/v) of some 70 elements, and comparison of the observed spectra with both recent published work and with the output of a computer program that allows calculation of transitions between the known energy levels, show that major improvements can be made in the coverage of spectral atlases for ICP-OES, with respect to “classical” line tables. It is argued that the atomic spectral data (wavelengths, energy levels) required for the reliable identification and documentation of a large majority of the weak interfering lines of the elements detectable by ICP-OES now exist, except for most of the observed lines of the lanthanide elements. In support of this argument, examples are provided from a detailed analysis of a spectral window centered on the prominent Pb II 220.353 nm line, and from a selected line-rich spectrum (W). Shortcomings in existing analyses are illustrated with reference to selected spectral interferences due to Zr. This approach has been used to expand the spectral-line library used in commercial ICP-ES instruments (Agilent 700-ES/5100-ES). The precision of wavelength measurements is evaluated in terms of the shot-noise limit, while the absolute accuracy of wavelength measurement is characterised through comparison with a small set of precise Ritz wavelengths for Sb I, and illustrated through the identification of Zr III lines; it is further shown that fractional-pixel absolute wavelength accuracies can be achieved. Finally, problems with the wavelengths and classifications of certain Au I lines are discussed.

Keywords: Wavelength tables; Inductively coupled plasma; gold, zirconium, and tungsten spectra