

contrAA[®] Dynamic Mode



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The contrAA[®] has always been appreciated for its extended working range and flexibility in signal evaluation. For ultra-trace analysis the contrAA[®] yields detection limits up to an order of magnitude better than traditional AAS technology. This improvement of detection limits is a result of the overall higher intensity of the light source, high quality optical components and a low-noise detection system. These, as well as simultaneous spectral background and lamp intensity corrections, all play their part in an improved signal-to-noise ratio, resulting in better detection limits.

At the same time the dynamic range can be extended towards higher concentrations by using secondary wavelengths with sensitivities matching actual sample concentrations. Since the light source provides a continuous emission, all wavelengths of all elements are available – unlike hollow cathode lamps that usually provide only one or two useful wavelengths per element. This makes multiple sample dilutions, otherwise required to bring samples into traditional instruments' working ranges, a matter of the past.

Flexible evaluation of the absorption signal allows more adaptations, depending on the purpose of the analysis. Adjusting the integration range of an absorption line, for example, allows optimization for highest sensitivity, best detection limit or extended linear range.

The contrAA[®] 800 series automates these features in the Dynamic Mode. It is a tool to automatically or manually adjust the dynamic working range of the instruments according to the concentrations encountered in samples. The Dynamic Mode also enables the connection of multiple calibration curves to provide a wide-range calibration over up to five orders of magnitude, allowing measurements of ultra-trace- and major elements in the same sample with a single method, thus offering a dynamic range similar to that of ICP-OES instruments.

Reduction of sensitivity is achieved by evaluating an absorption line on its less sensitive sides, instead of the center where sensitivity is highest. This is possible thanks to the CCD detector using multiple pixels to cover each absorption line, and the freely selectable evaluation pixels. The further from the center these evaluation pixels are, the higher the calibration range. This becomes obvious in Fig. 1 where the same absorption line is evaluated at different positions (evaluation pixels marked in red), giving different calibration ranges across five orders of magnitude (5 µg/L to 500 mg/L). As this procedure relies on different evaluation parameters of the same absorption line, all values can be obtained from a single measurement and can be combined in an analytical method.

Technical Note

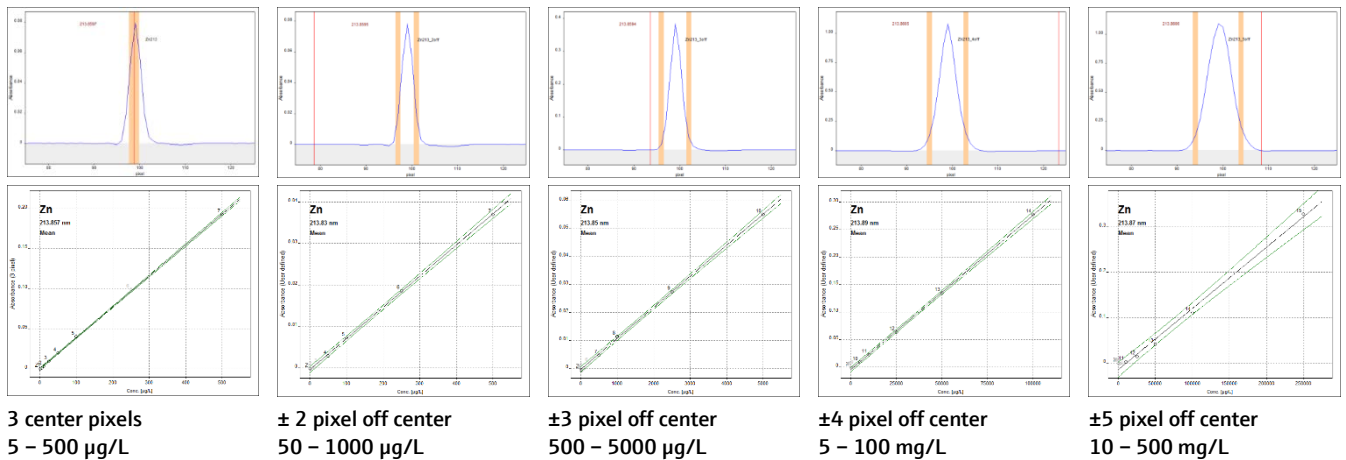
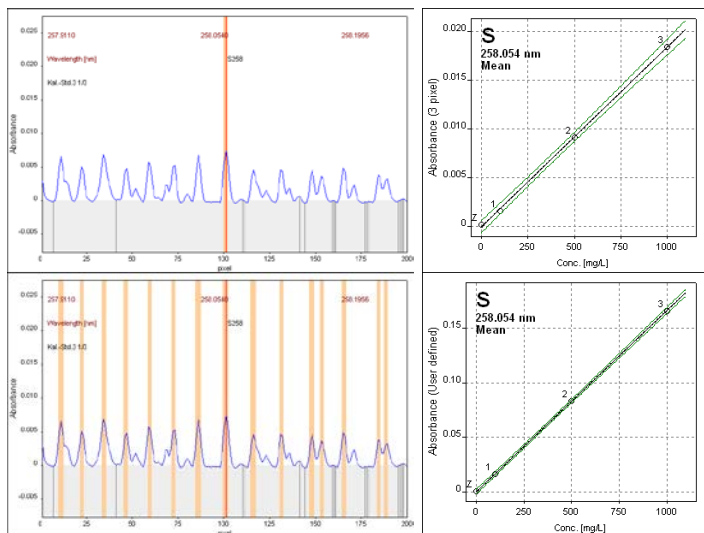


Fig. 1: Adjustment of the calibration range across five orders of magnitude using side-pixel-evaluation

Besides adjustment of the working range, the flexible evaluation of signals also allows to improve the performance for certain applications. The analysis of Sulfur via the CS molecule at 258nm is an example for significant improvements in detection limit, sensitivity and precision. Many diatomic molecules produce characteristic, fine-structured absorption bands over a wide wavelength range, providing many options for optimization. Best performance can be achieved by combining the most sensitive parts of a molecular spectrum and adding their absorbances, drastically increasing sensitivity. Fig. 2 shows the improvement of switching from standard 3-pixel-evaluation to user-defined signal evaluation.



3 Pixel evaluation:

Slope = 0.018 Abs / 1000mg/L
LOD = 25.5 mg/L
 $c_0 = 236$ mg/L
Method SD = 10.8 mg/L

Max. Pixels of each line (35 Px.):

Slope = 0.166 Abs / 1000mg/L (9x)
LOD = 6.6 mg/L (4x)
 $c_0 = 26.3$ mg/L (9x)
Method SD = 4.2 mg/L (2.5x)

Fig. 2: Optimization of sensitivity, LOD and precision using user-defined signal evaluation

The ASpect CS software allows user-defined evaluation parameters, including multiple parameter sets for the same line, to be specified as method parameters individually for each wavelength, thus providing maximum flexibility, widest working range and an analytical performance tunable according to the requirements of any application.