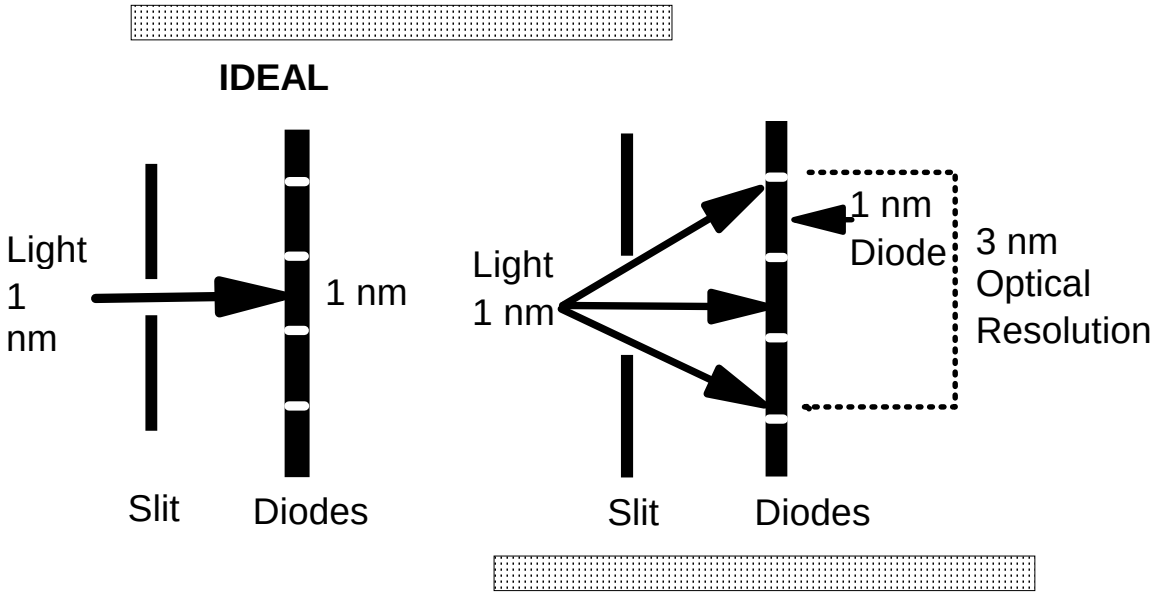
Performance PerSPECtives

Optical Resolution of Photodiode Array Detectors

Optical resolution is critical to the quality of spectra.



Optical resolution or bandwidth is an important property of photodiode array detectors (PDA). Optical Resolution affects several aspects of the performance, such as spectral resolution, sensitivity and linearity. Optical resolution is defined by design elements of the optics bench, such as the slit. In a PDA detector, the ideal situation is each wavelength (1 nm) of light passes through the sample and strikes one diode (left figure). This gives the best optical resolution of 1 nm. If the 1 nm of light is spread out over three diodes it results in 3 nm optical resolution (right figure), which will not provide as good spectral data because each wavelength is less focused.

The term optical resolution should not be confused with other terms used in the specifications of PDA detectors, such as diode or digital resolution. These numbers are obtained by determining the number of wavelengths monitored (e.g. 190 to 800 nm equals 610 wavelengths) divided by the number of diodes in the detector's array (e.g. 512) for 1.2 nm diode resolution. However, it is important to remember that it is the optical resolution that affects what the chromatographer observes in chromatographic and spectral data.

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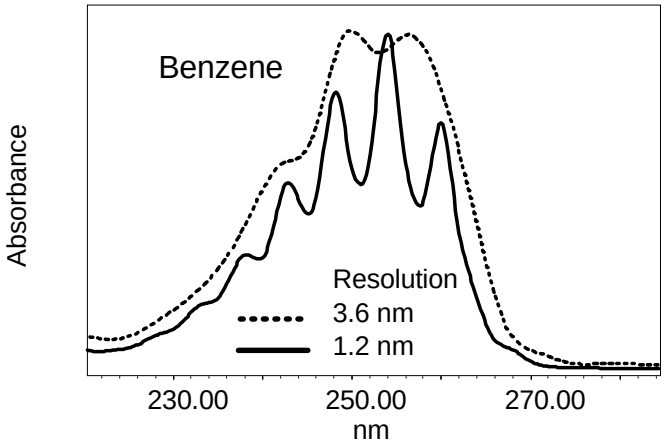
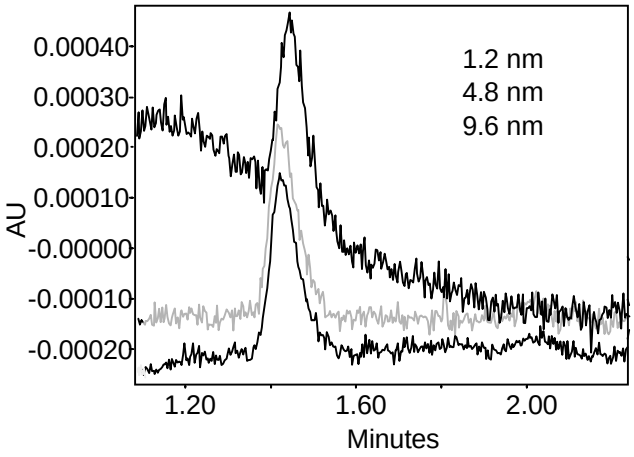
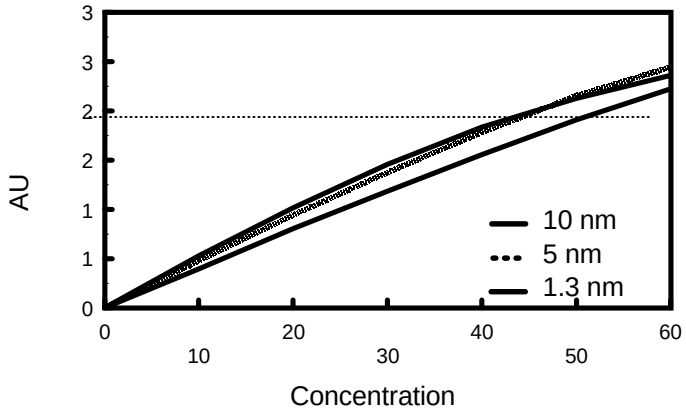
★ Effects of Optical Resolution



Optical resolution will determine the amount of detail observed in spectra. Benzene illustrates the spectral fine structure that can be seen at 1.2 nm resolution compared to 3.6 nm. 1.2 nm resolution is also required to distinguish between very similar compounds. For the highest quality spectral information which provides confident peak identification, the best optical resolution is required.



Baseline noise decreased some as the bandwidth increased from 1.2 to 9.6 nm (optical resolution decreased). However, if you increase the bandwidth by increasing the slit width, you will lose optical resolution and linearity. This degrades the quality of the overall analytical method, and demonstrates the compromise in PDA detector performance when design is changed.



The better the optical resolution (smaller bandwidth), the better the linearity of the absorbance vs. concentration curve. 1.3 nm is better than 5 or 10 nm.

Waters 996 Photodiode Array Detector has 1.2 nm optical and diode resolution. It has linearity to 2 AU across the entire wavelength range of 190-800 nm and a noise specification of ±1.5 x 10-5 AU. These provide uncompromised chromatographic and spectral data with the best optical resolution.