

# Spectrometer

# Selection



Thunder Optics

— Science and knowledge for all —

www.thunderoptics.fr 06/2024



# STRATEGIC SPECTROMETER SELECTION: DETECTORS, SENSITIVITY, RESOLUTION, AND PRICE CONSIDERATIONS

## INTRODUCTION:

Choosing the ideal spectrometer for your application involves a meticulous evaluation of critical factors, with a keen focus on detectors, sensitivity, resolution, and price. This guide will delve into the considerations surrounding CCD and CMOS detectors, while also exploring the intricacies of sensitivity and the impact of resolution parameters such as slit width and diffraction grating lines per mm.

## DETECTOR TECHNOLOGY:

### ⚡ CD vs. CMOSCCD (Charge-Coupled Device):

CCD detectors, renowned for high sensitivity and low noise, excel in applications demanding precision. Their ability to capture weak signals across a broad wavelength range makes them suitable for scientific research, environmental monitoring, and scenarios where signal integrity is paramount.



Nano-Spectrometer

### ⚡ CMOS (Complementary Metal-Oxide-Semiconductor):

CMOS detectors, characterized by cost effectiveness and versatility, have evolved to offer competitive performance. While historically featuring slightly lower sensitivity than CCDs, modern CMOS detectors are well-suited for applications with dynamic measurement requirements, thanks to faster readout speeds and cost efficient design.

Thunder Optics utilizes advanced CCD and CMOS (1D and 2D) detector technologies in the manufacturing of its spectrometers. For linear detectors, we exclusively use Hamamatsu detectors ensuring high performance and precision.

## SENSITIVITY:

Evaluate the quantum efficiency, noise characteristics, and dynamic range of CCD and CMOS detectors. Consider the minimum detectable signal and the signal-to-noise ratio, aligning the spectrometer's sensitivity with the specific requirements of your experiments or measurements.

The linear back-illuminated S16011 CCD and S11639 CMOS from Hamamatsu are the most sensitive detectors used by Thunder Optics, followed by the Sony IMX 2D monochrome detector, and then the color version.

## RESOLUTION:

### Slit Width:

The slit width is a crucial parameter affecting resolution. A narrower slit width enhances spectral resolution but reduces the amount of light entering the spectrometer. Balancing slit width is essential, ensuring sufficient light for sensitivity while achieving the required spectral detail.

Thunder Optics offers a range of slits widths: 25, 50 and 100  $\mu\text{m}$ . Nano Spectrometer offers the option of interchangeable slits.

### Diffraction Grating (Lines per mm):

The diffraction grating plays a key role in dispersing light into its spectral components. Higher lines per mm result in greater dispersion and finer spectral features, offering higher resolution. However, this may come at the cost of decreased light intensity. The choice of diffraction grating should align with the balance between resolution and sensitivity required for your application.



M-Spectrometer



Mini Spectrometer

## PRICE:

While performance is paramount, cost considerations are practical. Compare the prices of spectrometer models equipped with CCD and CMOS detectors, factoring in initial costs and long-term expenses. CMOS detectors often provide a cost-effective solution.

## CONCLUSION:

Selecting the optimal spectrometer demands a comprehensive analysis of detector technology, sensitivity, resolution, and price. Understanding the distinctions between CCD and CMOS detectors allows for tailored solutions. Balancing sensitivity with resolution parameters like slit width and diffraction grating lines per mm ensures the spectrometer meets your application's unique demands. A strategic approach to these considerations guarantees an informed decision that optimizes performance within budget constraints, making your chosen spectrometer a wise investment for precise and cost-effective measurements.

Mini -  
Spectrometer

C -  
Spectrometer

M -  
Spectrometer

O -  
Spectrometer



Specifications				
Detector Type	2D CMOS	Sony - 2D CMOS	Sony - 2D CMOS	Hamamtsu S11639
Sensitivity	*	**	***	*****
Stray Light	*	**	**	*****
Range (nm)	400-850	360-885	360-885	200-1100 (a)
Order Sorting Filter	No	No	No	Yes
SMA Connector	No	Yes	Yes	Yes
Slit (µm)	100	50, 100	50, 100	10, 25, 50, 100 (a)
Grating (l / mm)	1000	1000	1000	300, 600, 1200, 1800, 2400 (a)
Signal (bit)	8	8	8	16
I / O Ports	No	No	No	Yes
Dimension (mm x mm x mm)	80 x 36 x 105	80 x 45 x 125	80 x 45 x 125	102x 72 x 34
Weight (gr)	190	300	300	350
Applications				
Raman Spectroscopy	n/a	n/a	n/a	*****
Irradiance - colorimetry - CEI	n/a	n/a	n/a	***** (a)
PhotoLuminescence (PL)	n/a	**	****	*****
Gemmology	n/a	***	****	*****
Reflectance Spectroscopy (FORS)	n/a	**	***	*****
Environmental Science	n/a	**	**	*****
Food & Agriculture industry	n/a	*	**	*****
Chemical processes	n/a	*	**	*****
Forensic analysis	n/a	*	*	*****
Abosorbance - Transmittance	*	***	***	*****
Education	*****	*****	*****	*****
Spectroscopy Kit	Starter	Guru C	Guru M Gemo M	GemoPro Pro Pro UV
Price	*	**	**	***

(a) : Please specify when placing the order