



QDot™ Perovskite Quantum Dots Application Guide

THE NEXT GENERATION MATERIAL FOR OPTOELECTRONICS:

- 1 Broad absorbance and high stopping power for X-rays, γ -rays and UV light
- 2 Superior photoemissive material with broad absorption and tunable wavelengths emission (450 – 530 nm)
- 3 Near unity PLQY (up to 100 %), fast decay time (nanoseconds range)

About Quantum Solutions:

Quantum Solutions develops and manufactures quantum dot materials and technology for wide range image sensors. Our innovative QDot™ materials can be found in industrial devices around the world.

MAIN APPLICATION AREAS:

X-RAY IMAGING

High-efficiency scintillator material for X-ray detection



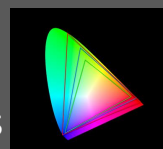
UV SENSORS

Increases UV sensitivity of Si based photodetectors



LCD Display

Enhances color gamut and brightness



QD LEDs

For widest colour gamut and highest contrast displays



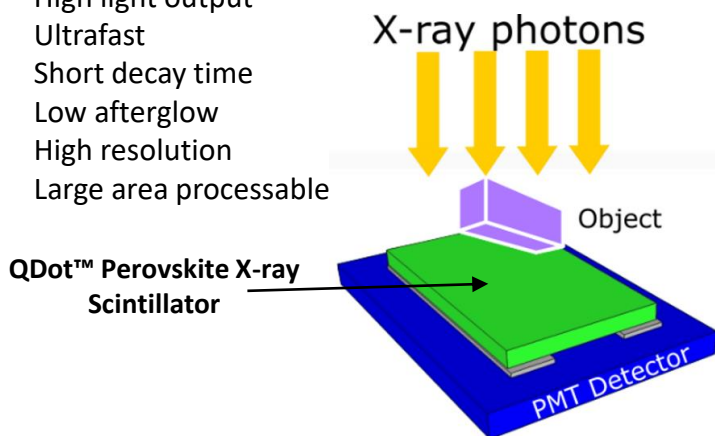


QDot™ Perovskite X-ray Scintillator

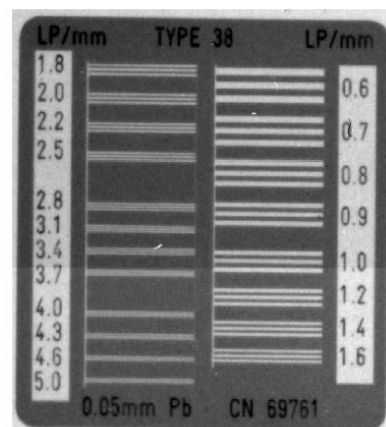
X-ray scintillators, which are capable of converting ionising radiation into visible photons, are very important for such areas as: inspection, failure/cracks detection, security X-ray imaging, nuclear cameras, and computed tomography. [QDot™ Perovskite X-ray Scintillators](#) exhibit strong visible luminescence under X-rays, and this luminescence can be read by conventional silicon imaging cameras or CMOS readouts. QDot™ Perovskite X-ray Scintillators can be used as efficient X-ray scintillators alternative to CsI(Tl) and GADOX scintillators due to their compelling combination of high light output, impressive resolution, high radiation hardness and ultrafast speed. Read [this article](#) to learn more about the technology.

SCINTILLATOR BENEFITS:

- Highly sensitive material for X-ray scintillation
- High light output
- Ultrafast
- Short decay time
- Low afterglow
- High resolution
- Large area processable



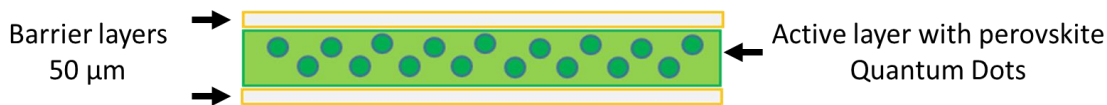
IMAGING EXAMPLE:



Imaging of line-pair phantom using QDot™ Perovskite X-ray Scintillator

SCINTILLATOR PERFORMANCE:

[QDot™ Perovskite X-ray scintillators](#) are in the product development step. Evaluation products are available for purchase. The product consists of a polymer film with perovskite quantum dots protected by barrier layers from both sides.



Light output (%CsI(Tl)*)	Light output (% GADOX**)	Resolution (MTF = 0.2)	Decay time to 10%	Afterglow <0.1%	Matrix type	QDot concentration, wt%	Film Sizes	Active layer thickness
Up to 100%	Up to 50%	7-11 lp/mm	< 1 μs	2 ms	Polyme r resin	50 wt%	Variable up to 15×15 cm	Variable 100-300 μm

*CsI(Tl) columnar scintillator (same thickness), Hamamatsu, 70 kV.

**Gadolinium oxysulfide (Tb) (same thickness), Mitsubishi, 70 kV.



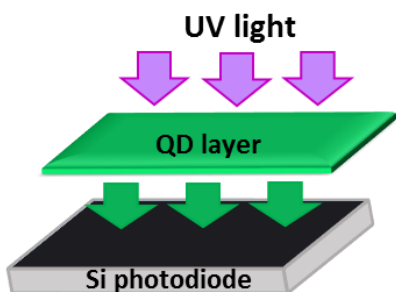


QDot™ Perovskite ABX3 Quantum Dots for UV Sensors

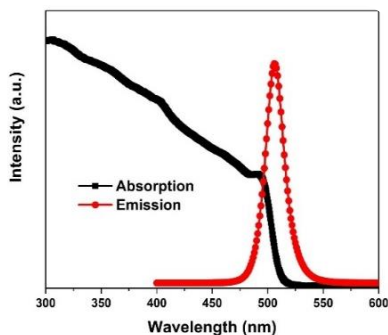
Silicon photodiode is the most widely used commercial photodetector for a broad range of applications, from imaging to light sensors. Unfortunately, it has low responsivity and struggles to capture photons in the UV light range (< 400 nm), due to the low penetration depth of high energy UV photons into silicon-based materials. QDot™ Perovskite Quantum Dots can be utilised as a colour-converting layer to enhance the UV light sensitivity of Si-based photodetectors.

BENEFITS:

- High photo-conversion of UV light into visible light (PLQY up to 100 %)
- High absorption coefficient of UV light
- Tunable emission 450-530 nm



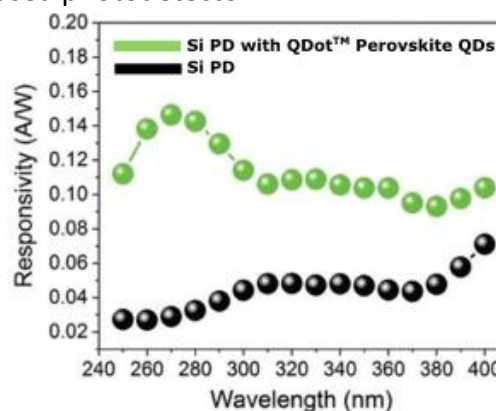
QDot™ Perovskite QDs UV sensor architecture



QDot™ Perovskite QDs absorption and emission spectra

DEVICE EXAMPLE:

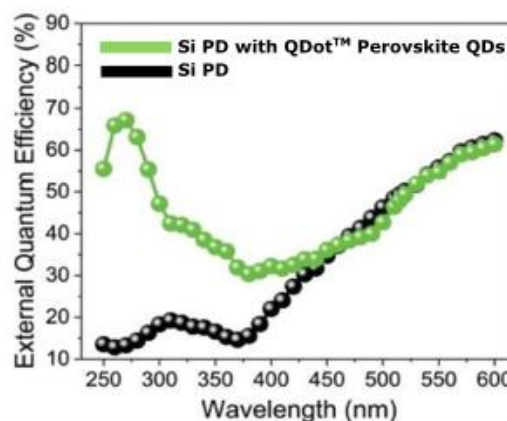
QDot™ Perovskite QDs can convert UV light into lower energy green light where Si-based photodetectors have a high sensitivity. QDot™ Perovskite QDs ABX3-510 can be used in the form of QDs in a polymer film or a spin coated layer on top of the Si-based photodetector.



SENSOR PERFORMANCE:

Parameter	Typical value
QDs peak emission	Tuneable 450-530 nm
PLQY at UV light excitation	Up to 100 %
UV light absorption range	100-400 nm
PL decay time (372 nm)	4.5 ns
Responsivity improvement of Si-PD with QDot™ Perovskite QDs	100 – 1000 times

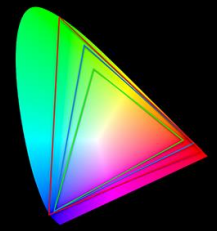
By utilising only a very thin layer of QDot™ Perovskite QDs on top of Si-based photodetector, the responsivity of the devices increases in response to UV light, without sacrificing the response to the visible light.



Products portfolio:

[QDot™ Perovskite ABX3 Quantum Dots](#)



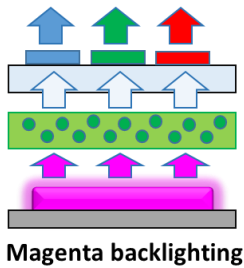


QDot™ LCD SharpGreen Perovskite Film for Displays

QDot™ LCD SharpGreen Perovskite Film is the colour enhancement film that allows LCD displays to achieve an exceptionally wide colour gamut (over 85% of Rec2020 standard) and outstanding brightness. This makes display images look more lifelike, close to the way that our eyes perceive images in the real world. QDot™ LCD Film is a polymer composite with embedded, green emitting perovskite quantum dots. The material is RoHS compliant and cadmium free. The film exhibits bright green emission centred at 525 nm, high photoluminescent quantum yield (PLQY > 80 %) and narrowband emission (FWHM < 20-25 nm) all of which make it a better quality alternative to the current CdSe or InP QDs.

BENEFITS:

- Bright green colour emission centred at 525 nm for high Rec2020 color gamut coverage
- The narrowest FWHM among all QDs (< 20-25 nm)
- High PLQY up to 100 %
- RoHS compliant for LCD backlighting, cadmium free
- High reliability



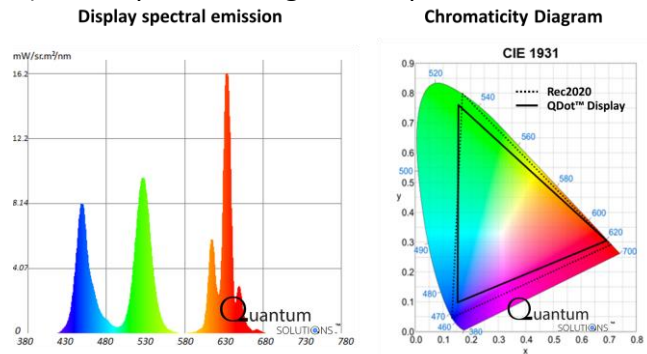
QDot™ LCD SharpGreen Perovskite Film display architecture

LCD PERFORMANCE:

Parameter	Typical values
Rec2020 color gamut coverage/ratio	> 84% / > 86%
DCI-P3 color gamut coverage/ratio	> 92% / > 115%
sRGB color gamut coverage/ratio	> 98% / > 158%
Brightness	Up to 1500 nits

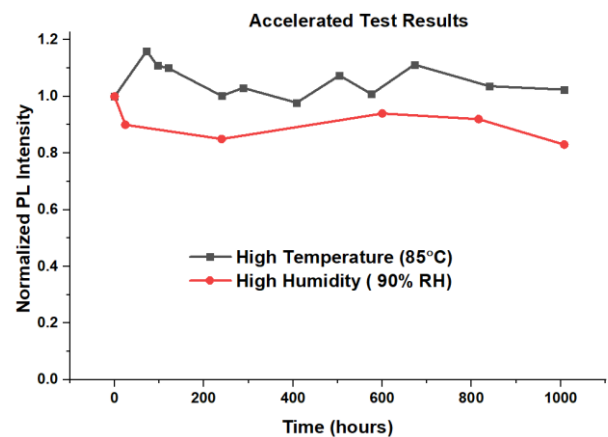
DEVICE EXAMPLE:

QDot™ LCD SharpGreen Perovskite Film is used as a LCD backlighting unit in combination with magenta LEDs. The LCD display demonstrates high color gamut coverage (Rec2020 > 84%, DCI-P3 > 92% and sRGB > 98%) and impressive brightness up to 2000 nits.



RELIABILITY:

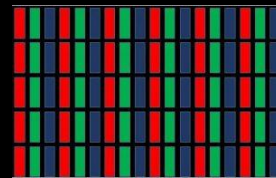
QDot™ LCD SharpGreen Perovskite Film has high reliability under heat, high flux and humidity. It retains > 80 % of initial photoluminescence within 1000 hours of accelerated exposure tests under high heat and humidity and > 50% of initial photoluminescence under high flux conditions.



Products portfolio:

[QDot™ LCD SharpGreen Perovskite Film](#)



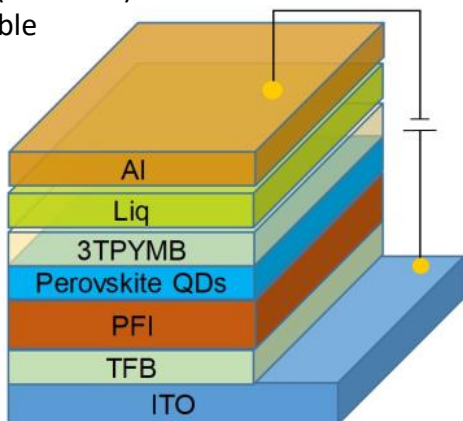


QDot™ Perovskite ABX3 Quantum Dots for QD LEDs

QD LEDs is an emerging technology that promises to enhance current OLED displays with higher brightness, durability and colour purity. It will be an ultimate solution for flexible and curved displays in TVs, mobile and wearable devices, virtual and augmented reality glasses, automotive displays and signage. QDot™ Perovskite ABX3 Quantum Dots show great promise in that field, alongside with InP and CdSe quantum dots. QDot™ Perovskite ABX3 powders QDs are especially efficient for blue and green QD LEDs.

BENEFITS:

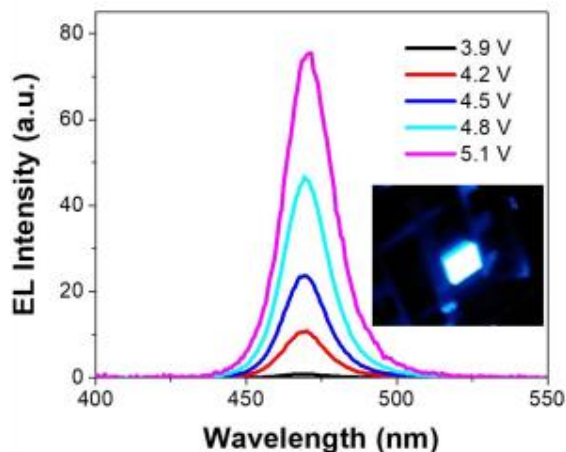
- High brightness (from 500 Cd/m² for blue and from 1000 Cd/m² for green lights)
- High EQE (from 2% for blue and 5% for green)
- Short decay time (< 5-20 ns)
- Solution processable



QDot™ Perovskite QDs QLED architecture

DEVICES EXAMPLE:

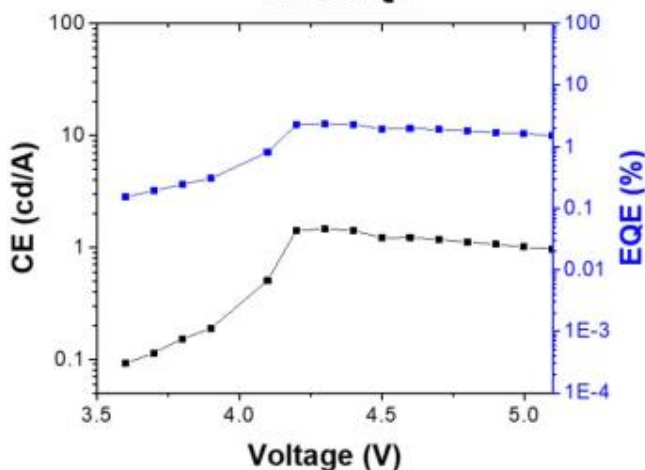
QD LED based on green QDot™ ABX3-510 powder exhibits strong electroluminescence at 510 nm with FWHM 18 nm. EQE max is > 5 % with luminance max > 1000 Cd/m². QD LED based on blue QDot™ ABX3-450 powder demonstrates emission at 450 nm with FWHM 20 nm. It has relatively high EQE max over 2 % with brightness 500 Cd/m².



QD LED PERFORMANCE:

	QDot™ ABX3-450 powder	QDot™ ABX3-510 powder
QDs core type	CsPb(Cl/Br) ₃	CsPbBr ₃
Emission	450 nm	510 nm
FWHM	< 20 nm	< 20-25 nm
Decay time	< 5-20 ns	< 5-20 ns
EQE max	> 2 %	> 5 %
Luminance max	> 500 cd/m ²	> 1000 cd/m ²

CE & EQE



Products portfolio:

[QDot™ Perovskite ABX3 Quantum Dots \(powders\)](#)

