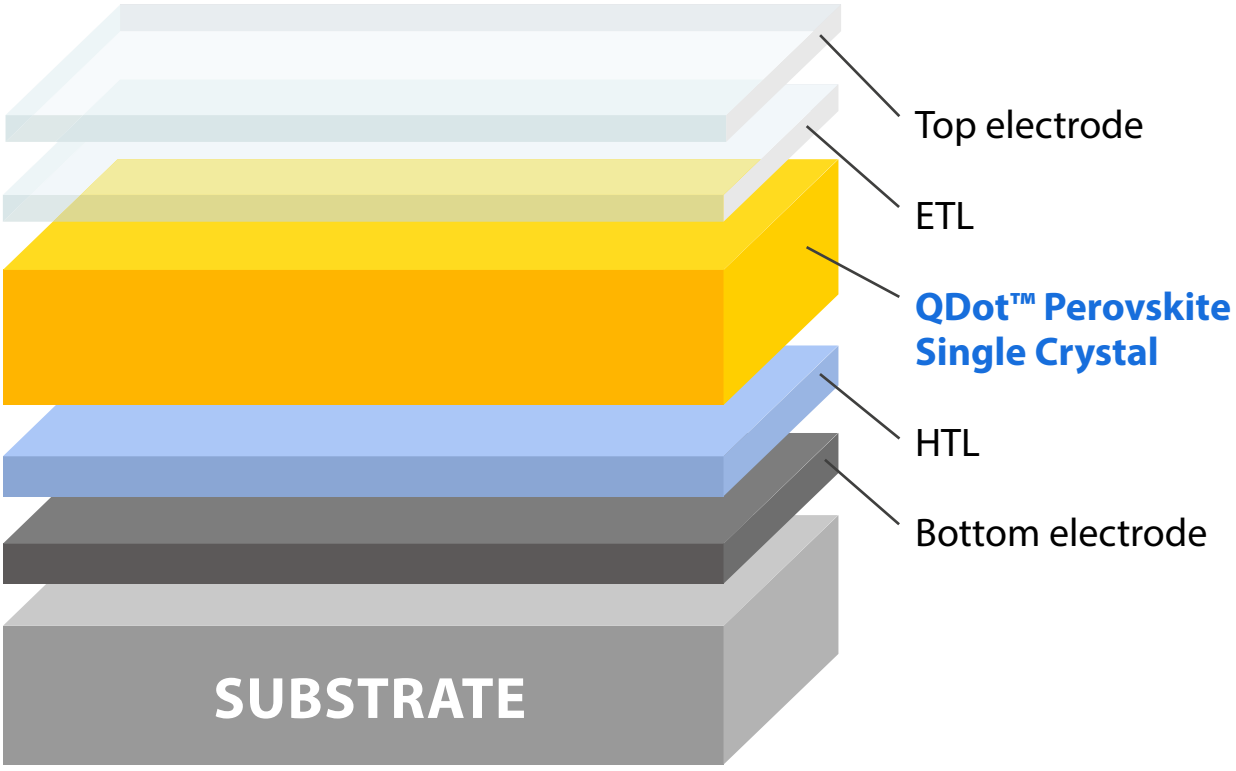
Quantum SOLUTIONS®

QDot™ Perovskite Single Crystals

Technical Data Sheet

Introduction and product highlights

Perovskite single crystals have excellent X-ray photoelectric properties due to their high X-ray light absorption coefficients, long-range balanced electron and hole transport, long carrier diffusion lengths (as long as 3 mm), and remarkably low trap densities ($<10^{10}$ cm^{-3}). This material is positioning it as the best alternative to CdTe and CdZnTe (CZT) crystals used in direct X-ray sensors. While CZT offers excellent absorptivity, it requires high-temperature processing conditions (>900 °C) and suffers from structural imperfections and compositional inhomogeneity. In contrast, perovskite single crystals possess the unique advantage of facile preparation using solution techniques at low (<100 °C) or even room temperature, enabling controlled growth of crystals with desired sizes and thicknesses at a low cost and high processing speed.



QDot™ Perovskite Single Crystals can be integrated into a QDot™ X-ray photodiode stack using bonding techniques. In principle, a QDot™ X-ray photodiode stack consists of a substrate, bottom electrode, a hole transport layer (HTL), a QDot™ Perovskite Single Crystal absorber, an electron transport layer (ETL), and a top electrode. These novel solution-based single crystals have made it possible to create highly efficient X-ray direct detectors with increased sensitivity at an affordable cost.

The product is launched in collaboration with AYsensors: www.aysensors.com

QDot™ Perovskite Single Crystals offer the following advantages:

- ✔ Solution-processed compound semiconductor single crystals to be used in direct X-ray photodetectors and image sensors.
- ✔ High crystallinity and purity perovskite single crystals are grown at low temperatures, enabling precise control over crystal stoichiometry and dimensions.
- ✔ Excellent X-ray light absorption coefficients, long-range balanced electron and hole transport, long carrier diffusion lengths, and remarkably low trap densities that result in high X-ray detectivity.

Table 1. Specification of QDot™ perovskite single crystals

QDot™ Catalogue Number	SC-MAPbBr3	SC-CsPbBr3
Active material	$MAPbBr_3$ (methylammonium lead bromide)	$CsPbBr_3$ (cesium lead bromide)
Appearance	Transparent orange crystal	Transparent orange crystal
Crystal shape	Rectangular prism	Rectangular prism
Crystal size	10 × 10 × 3 mm 5 × 5 × 2 mm	5 × 5 × 2 mm
Band gap	2.2 eV	2.2 eV
Crystallinity (FWHM of the rocking curve peak of (100) plane by XRD)	< 50 arcsec	< 100 arcsec
Trap density	$<10^{10}$ cm^{-3}	$<10^{10}$ cm^{-3}
Device integration method	Thermal deposition of HTL, ETL and electrodes on the single crystal	

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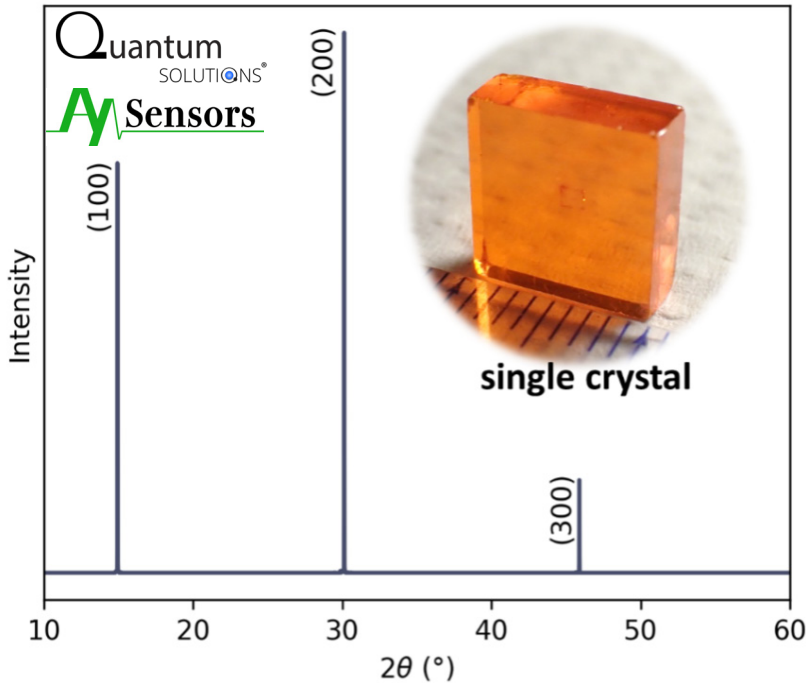
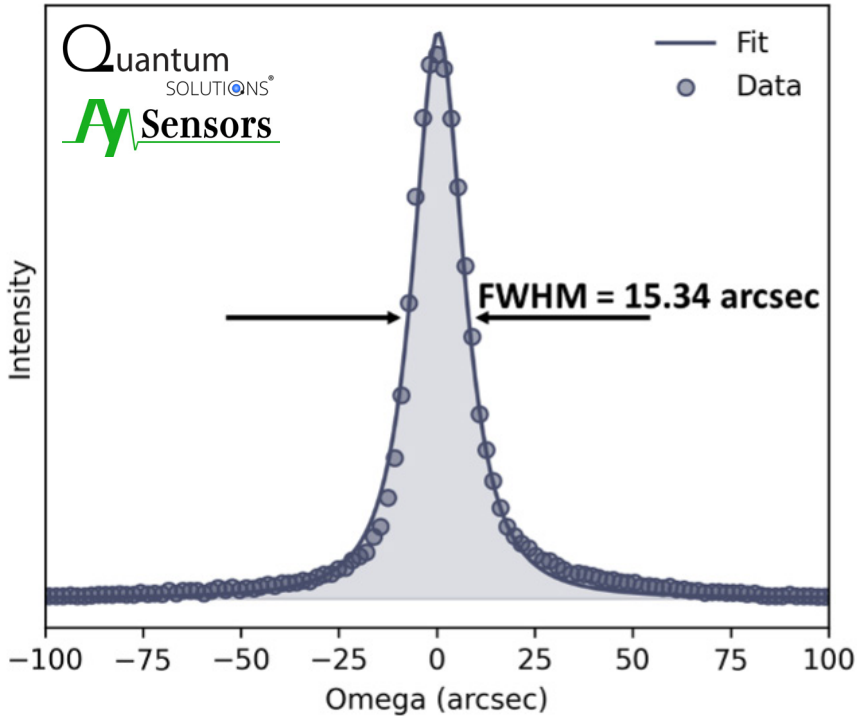
XRD pattern of QDot™ MAPbBr3 single crystal



High-resolution X-ray (XRC) diffraction rocking curves of QDot™ MAPbBr3 single crystal



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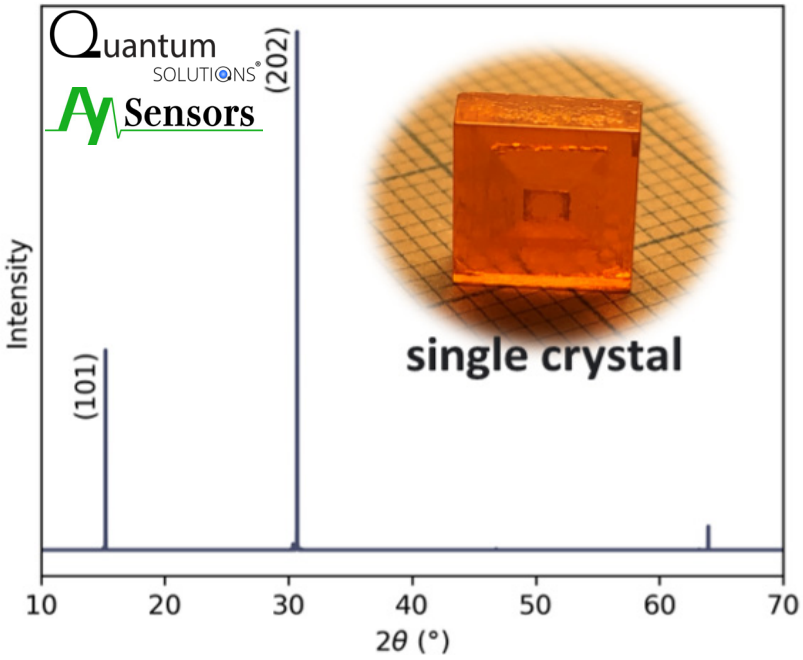
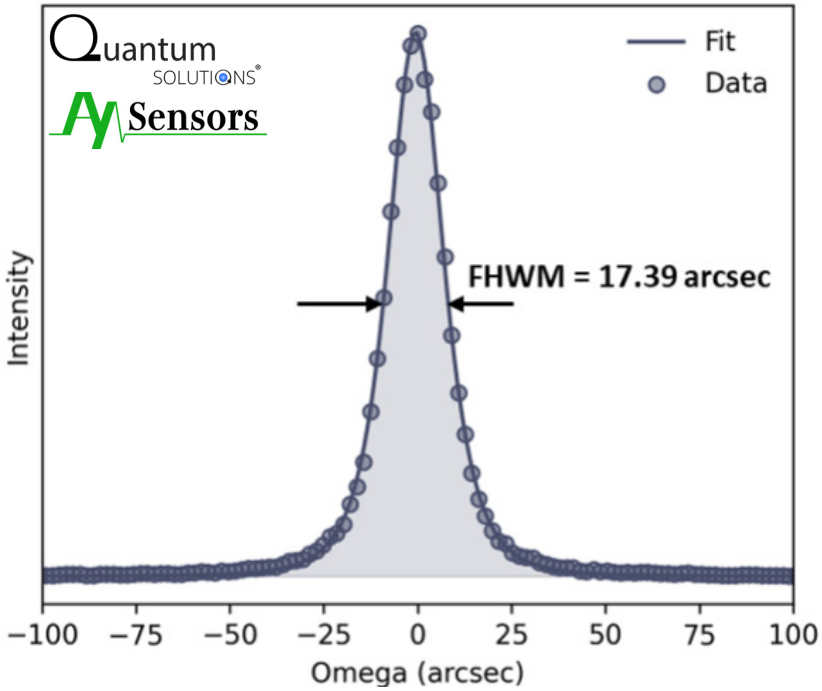
XRD pattern of QDot™ CsPbBr3 single crystal



High-resolution X-ray (XRC) diffraction rocking curves of QDot™ CsPbBr3 single crystal



Notes for handling

Shelf Life 12 months. Shipping and storage temperature 4-25 °C. Store in DARK conditions, in original packaging or in airtight, sealed packaging inside a glovebox. Repackage in a glovebox only. Avoid contact with air. Process inside the glovebox or another enclosed inert gas environment.

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