Quantum SOLUTIONS™

QDot™ PbS quantum dot n-type ink

Technical Data Sheet

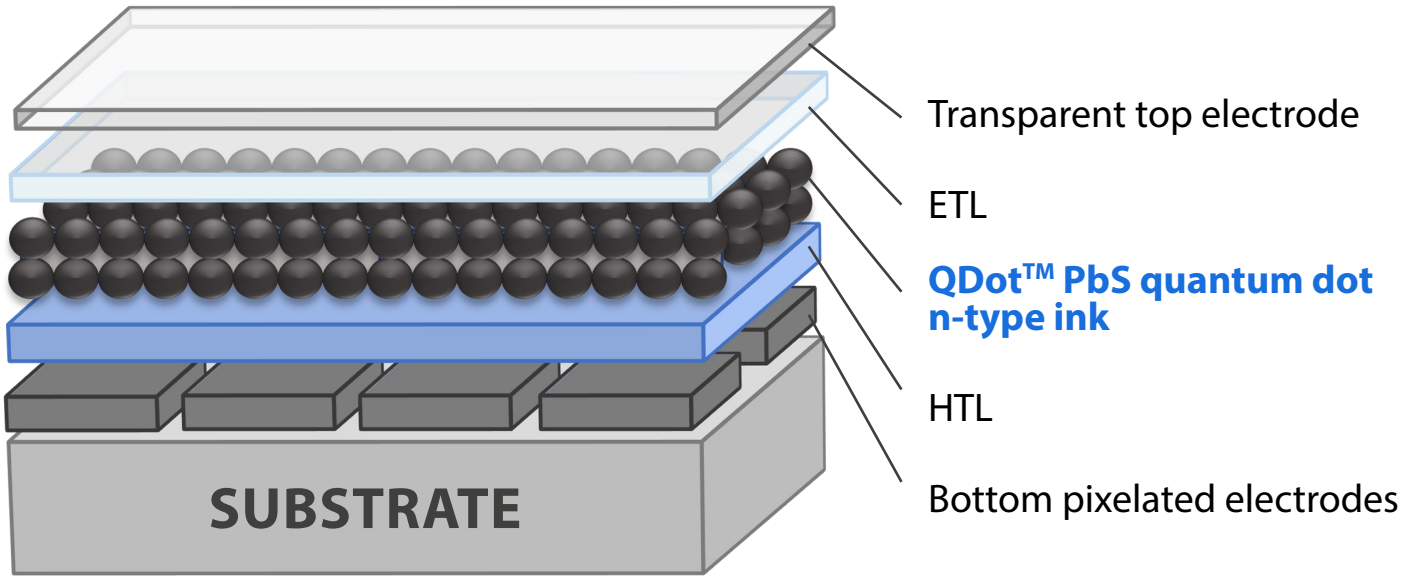
Introduction and product highlights

Quantum Solutions offers a range of materials for fabricating the QDot™ photodiode stack, which can be used in sensing and imaging applications. The principal device structure comprises several thin layers, referred to as the QDot™ stack, placed on top of a substrate. Working from the bottom up, the structure includes a bottom electrode, HTL (hole transporting layer), quantum dots absorber, ETL (electron transporting layer), and transparent top electrode.

QDot™ stack materials, including HTL, quantum dots, and ETL, can be deposited from solution onto any target substrate, such as glass, silicon, or a ROIC platform, using spin-coating methods.

These novel solution-based methods for manufacturing thin films of compound semiconductor materials have made it possible to create artificial nanocrystalline structures that offer unprecedented possibilities. Unlike epitaxial layers, the quality of quantum-dot semiconductors is less dependent on the crystallographic characteristics of substrates and their interfacial relationships. Solution-based methods provide flexibility and broad material choice for specialised carrier transport layers enabling tuneable photodiode functions.

Quantum Solutions provides the QDot™ PbS quantum dot n-type ink (n-ink), specifically designed for the fabrication of highly efficient SWIR (short-wave infrared) pho-



todiodes and image sensors. The n-ink is negatively doped, which means the work function of thin films is close to the conduction band of the material. QDot™ PbS n-ink provides several advantages. Firstly, it eliminates the need for complex solid ligand exchange procedures. Secondly, it enables the straightforward creation of a relatively thick quantum dot absorber layer, up to 100 nm. This layer can be effortlessly deposited onto a substrate using techniques such as spin-coating or other solution processing methods. Multiple layers deposition is possible to achieve the desired thickness 200-400 nm. Furthermore, QDot™ PbS n-ink offers exceptional cost-efficiency in terms of ink consumption. Only 5 mL of this ink are required to coat one layer on a large 200 mm wafer, making it a practical choice for scaling up production processes in the field of SWIR photodiodes and image sensors.

QDot™ PbS Quantum Dot n-type ink offers the following features:

- ✔ Efficient solution-processed photoelectric absorber nanomaterial for use in short-wave infrared (SWIR) photodetectors and image sensors.
- ✔ Simple one-step deposition on substrates by spin-coating processes, forming a thick (80-100 nm) quantum dot absorber layer. No ligand exchange process required. Multiple layers deposition is possible to achieve the desired thickness 200-400 nm.
- ✔ Extremely economical material consumption, with 5 mL being sufficient for coating one layer on a large 200 mm wafer.
- ✔ A wide range of product availability from 4 to 12 nm of quantum dot size, covering the absorbance cut-off from 1000 nm to 2500 nm.
- ✔ Narrow particle size distribution (STDV < 5-10%) for the formation of a compact and defect-free quantum dot absorber layer.

General Specification	
Appearance	Black liquid
Deposition method*	Spin-coating (drop casting, dip coating, die coating, spray coating, inkjet printing)
Thin film thickness at 1000 rpm spin-coating	80 - 120 nm (depending on the particles size)
Consumption	10 – 20 µL/cm^2 (5 mL is sufficient for one layer in a 200 mm wafer)

**A detailed manual for the spin-coating process will be provided upon purchasing the product.*

Specification of QDot™ PbS quantum dot n-type ink

QDot™ Catalogue Number	Core type	Core size	Absorption peak in SWIR range	Absorbance range	Band-gap	Doping polarity**	Solid content
PbS-**900**-abs n-ink	PbS	3.2 nm	900±25 nm	400–1000 nm	1.22 eV	n	100 mg/mL
PbS-**1000**-abs n-ink	PbS	3.6 nm	1000±25 nm	400–1100 nm	1.11 eV	n	100 mg/mL
PbS-**1100**-abs n-ink	PbS	4.0 nm	1100±25 nm	400–1200 nm	1.04 eV	n	100 mg/mL
PbS-**1200**-abs n-ink	PbS	4.5 nm	1200±25 nm	400–1300 nm	0.96 eV	n	100 mg/mL
PbS-**1300**-abs n-ink	PbS	5.0 nm	1300±25 nm	400–1450 nm	0.89 eV	n	100 mg/mL
PbS-**1400**-abs n-ink	PbS	5.5 nm	1400±25 nm	400–1550 nm	0.84 eV	n	100 mg/mL
PbS-**1500**-abs n-ink	PbS	6.0 nm	1500±25 nm	400–1650 nm	0.79 eV	n	100 mg/mL
PbS-**1600**-abs n-ink	PbS	6.4 nm	1600±30 nm	400–1750 nm	0.75 eV	n	100 mg/mL
PbS-**1700**-abs n-ink	PbS	7.0 nm	1700±30 nm	400–1900 nm	0.71 eV	n	50 mg/mL
PbS-**1800**-abs n-ink	PbS	7.5 nm	1800±40 nm	400–2000 nm	0.67 eV	n	50 mg/mL
PbS-**1900**-abs n-ink	PbS	8.2 nm	1900±50 nm	400–2100 nm	0.64 eV	n	50 mg/mL
PbS-**2000**-abs n-ink	PbS	9.1 nm	2000±50 nm	400–2200 nm	0.61 eV	n	50 mg/mL
PbS-**2100**-abs n-ink	PbS	10.2 nm	2100±50 nm	400–2350 nm	0.59 eV	n	50 mg/mL
PbS-**2200**-abs n-ink	PbS	11.6 nm	2200±50 nm	400–2500 nm	0.56 eV	n	50 mg/mL

*** Detailed energy levels can be provided upon purchasing the product.*

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.