Quantum SOLUTIONS®

Q.Dot™ InAs quantum dot n-type ink

Technical Data Sheet

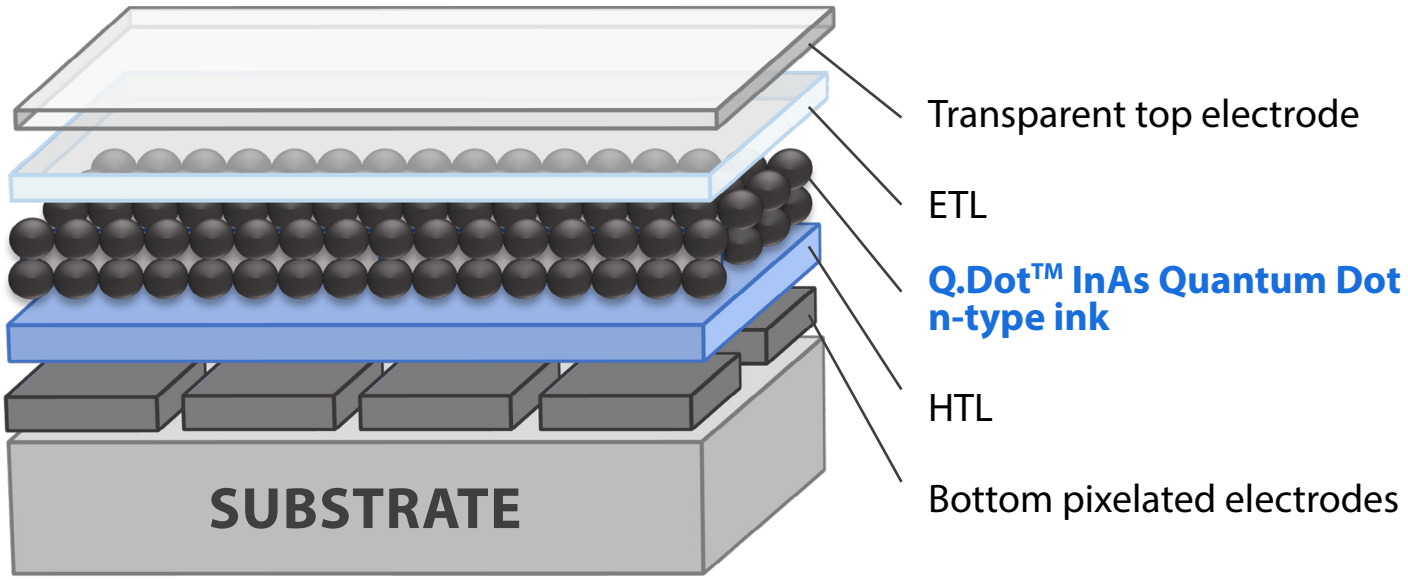
Introduction and product highlights

Quantum Solutions offers a range of materials for fabricating the Q.Dot™ photodiode stack, which can be used in sensing and imaging applications. The principal device structure comprises several thin layers, referred to as the Q.Dot™ 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.

Q.Dot™ 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 provide the Q.Dot™ InAs 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. Q.Dot™ InAs n-ink boasts several advantages. Firstly, it eliminates the need for complex solid ligand exchange procedures. Secondly, it enables the straight forward creation of a relatively thick quantum dot absorber layer, up to 100 nm. This layer can be simply deposited onto a substrate using techniques such as spin-coating or other solution processing methods.

Furthermore, Q.Dot™ InAs n-ink offers exceptional cost-efficiency in terms of ink consumption. Only 5 mL of this ink is required to coat a large 200 mm wafer, making it a practical choice for scaling up production processes in the field of SWIR photodiodes and image sensors.

Q.Dot™ InAs 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 (CMOS wafers, silicon, or glass wafers) by spin-coating processes, forming a thick (≈ 100 nm) quantum dot absorber layer. No ligand exchange process required.
- ✔ Extremely economical material consumption, with 5 mL being sufficient for coating a large 200 mm wafer.
- ✔ A wide range of product availability from 3 to 8.5 nm of quantum dot size, covering the absorbance cut-off from 900 nm to 1750 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/cm2 (5 mL is sufficient for one 200 mm wafer)

Specification of Q.Dot™ InAs Quantum Dot n-type

Q.Dot Catalogue Number	Q.Dot core type	Q.Dot core size	Absorption peak in SWIR	Absorbance range	Band-gap	Doping polarity	Solid content
InAs-**900**-abs n-ink	InAs	3.0 nm	900±25 nm	600–1050 nm	1.26 eV	n	50 mg/mL
InAs-**1000**-abs n-ink	InAs	4.5 nm	1000±25 nm	600–1150 nm	1.15 eV	n	50 mg/mL
InAs-**1100**-abs n-ink	InAs	5.5 nm	1100±25 nm	600–1250 nm	1.05 eV	n	50 mg/mL
InAs-**1200**-abs n-ink	InAs	6.5 nm	1200±25 nm	600–1350 nm	0.96 eV	n	50 mg/mL
InAs-**1300**-abs n-ink	InAs	7.0 nm	1300±25 nm	600–1550 nm	0.88 eV	n	50 mg/mL
InAs-**1400**-abs n-ink	InAs	7.5 nm	1400±25 nm	600–1650 nm	0.82 eV	n	50 mg/mL
InAs-**1500**-abs n-ink	InAs	8.5 nm	1500±25 nm	600–1750 nm	0.73 eV	n	50 mg/mL

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.