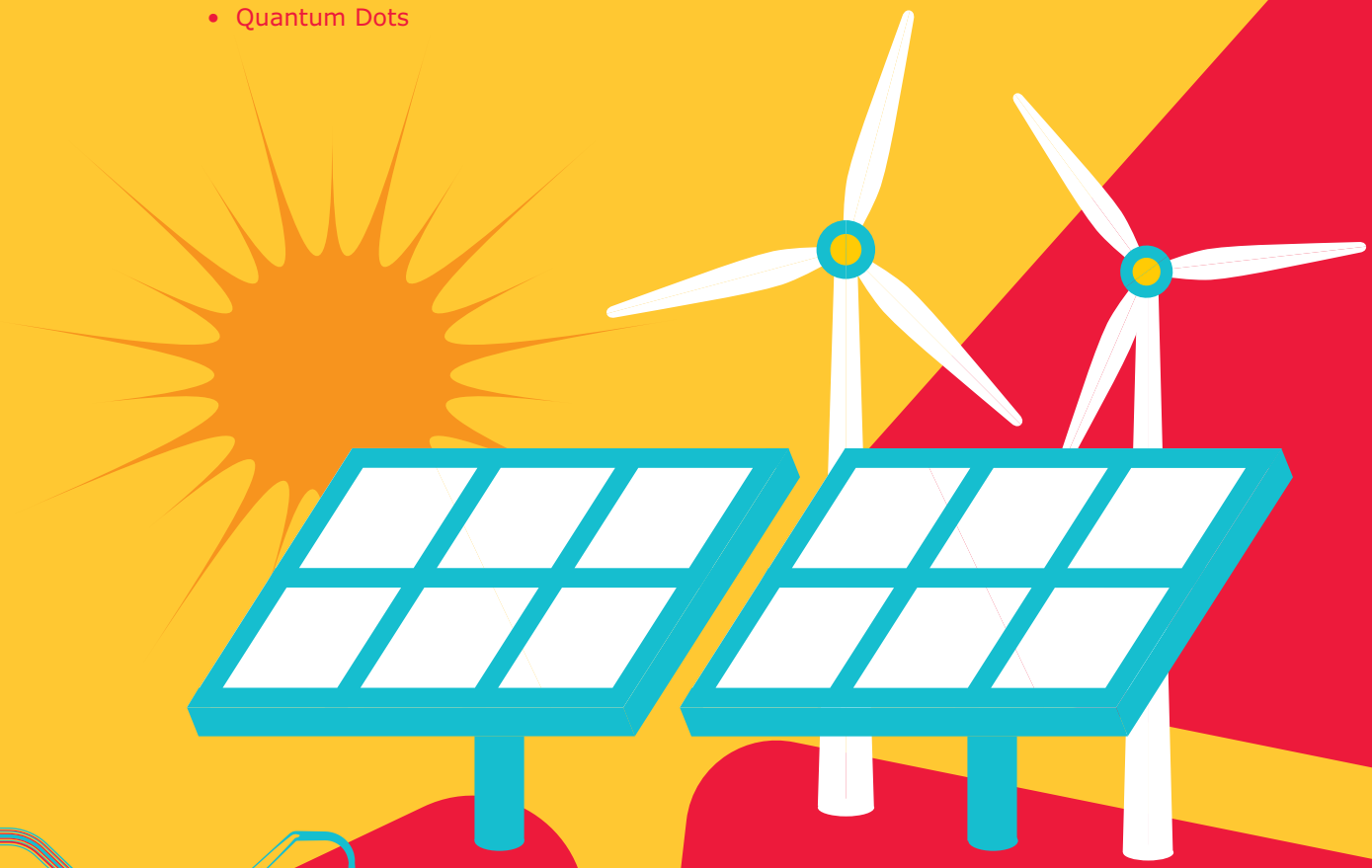
Sigma-Aldrich®
Lab Materials & Supplies

Nanomaterials
for Energy Generation, Storage, and Efficiency

- Inorganic Nanomaterials
- Graphene and Carbon Nanotubes
- Perovskite Materials
- Dye-Sensitized Solar Cell Materials
- Organic Photovoltaic (OPV) Donors and Acceptors
- Lithium Ion Battery Materials
- Quantum Dots



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The ever-increasing demand of energy has put tremendous pressure on our limited conventional fossil fuel resources. Over the past decade, it has become apparent that alternative energy based on solar, wind, and hydrogen are needed to meet future energy demands. Recently, nanomaterials have emerged as an important class of materials in addressing the energy crisis issue.

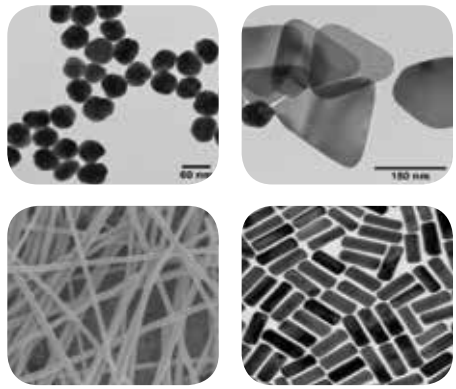
Nanomaterials with engineered morphology have been demonstrated to exhibit adapted properties rendering them useful for applications in solar cells, dye-sensitized solar cells, fuel cells, supercapacitors, sensors, electrochromic smart windows, and light-emitting diodes.

Nanomaterials have been demonstrated to help improve the energy efficiency of displays and solar cells as well. Sigma-Aldrich's materials science portfolio offers a wide selection of nanoparticles and nanostructures for the aforementioned applications.

Inorganic Nanomaterials

Metal-, oxide-, and ceramic-based nanoparticles, nanowires, and nanorods for applications in solar cells, fuel cells, photocatalysis, piezoelectrics, solid state lighting, sensors, smart windows, and touch screens.

For a complete list of available materials, visit **SigmaAldrich.com/nano.**



Nanopowders and Dispersions

Name	Form	Description	Product No.
Aluminum oxide	nanopowder	13 nm , 99.8% trace metals basis	**718475**
	dispersion	<50 nm, 20 wt. % in isopropanol	**702129**
Barium titanate	nanopowder (cubic crystalline phase)	<100 nm particle size, ≥99% trace metals basis	**467634**
Bismuth oxide	nanopowder	90-210 nm particle size, 99.8% trace metals basis	**637017**
Boron nitride	nanopowder	nanoplatelet, lateral dimensions <5 µm	**900408**
	nanopowder	nanoplatelet, lateral dimensions <1 µm	**900405**
	nanopowder	<150 nm avg. part. size, 99% trace metals basis	**790532**
	dispersion	nanoplatelet, 20 mg/mL in H_2O	**900417**
Calcium oxide	nanopowder	<160 nm particle size, 98%	**634182**
Carbon	nanopowder	<100 nm particle size	**633100**
Cerium oxide	dispersion	<5 nm (DLS), aqueous nanoparticle dispersion, 20% solids by weight, pH ~8	**796085**
Cobalt(II,III) oxide	nanopowder	<50 nm particle size, 99.5% trace metals basis	**637025**
Copper	nanopowder	<100 nm, <3% oxygen passivation, 99% trace metals basis	**794317**
Europium(III) oxide	nanopowder	<150 nm particle size, 99.5% trace metals basis	**634298**
Gold	suspension	5 nm diameter, OD 1, stabilized suspension in citrate buffer	**741949**
	suspension	20 nm diameter, OD 1, stabilized suspension in citrate buffer	**741965**
	suspension	100 nm diameter, OD 1, stabilized suspension in citrate buffer	**742031**
Indium tin oxide	dispersion	<100 nm particle size , 30 wt. % in isopropanol	**700460**
Iron(II,III) oxide	dispersion	10 nm avg. part. size, 5 mg/mL in H_2O	**725358**
	nanopowder	50-100 nm particle size, 97% trace metals basis	**637106**
Magnesium oxide	nanopowder	<50 nm particle size	**549649**
Molybdenum(IV) sulfide	nanopowder	90 nm diameter, 99% trace metals basis	**804169**
Nickel(II) oxide	nanopowder	<50 nm particle size, 99.8% trace metals basis	**637130**
Palladium	nanopowder	<25 nm particle size, ≥99.5% trace metals basis	**686468**
Platinum	dispersion	3 nm particle size, 1,000 ppm in H_2O, 99.99% trace metals basis	**773875**
Silicon	nanopowder	<100 nm particle size, ≥98% trace metals basis	**633097**
Silicon dioxide	nanopowder	10-20 nm particle size, 99.5% trace metals basis	**637238**
Silver	dispersion	10 nm particle size, 0.02 mg/mL in aqueous buffer	**730785**
	dispersion	40 nm particle size, 0.02 mg/mL in aqueous buffer	**730807**
Tin(IV) oxide	nanopowder	≤100 nm avg. part. Size	**549657**
Titanium(IV) oxide	nanopowder	21 nm primary particle size, ≥99.5% trace metals basis	**718467**
	nanopowder	nanotubes, 25 nm average diameter	**799289**
Tungsten(VI) oxide	nanopowder	<100 nm particle size	**550086**
Tungsten(IV) sulfide	nanopowder	90 nm avg. part. size, 99% trace metals basis	**790583**
Yttrium(III) oxide	nanopowder	<50 nm particle size	**544892**
Zinc oxide	dispersion	<100 nm particle size, 20 wt. % in H_2O	**721077**
Zirconium(IV) oxide	nanopowder	<100 nm particle size	**544760**

Nanowires

For a complete list of materials, visit **SigmaAldrich.com/nanowires.**

Name	Description	Product No.
Aluminum oxide	diam. × L 2-6 nm × 200-400 nm, powder	**551643**
Copper	diam. × L ~100 nm (±20 nm) × 10~20 µm, ~5 mg/mL in hexane	**808059**
	diam. × L ~100 nm (±20 nm) × 20~30 µm, ~5 mg/mL in ethanol	**807834**
Gold	diam. × L 30 nm × 6,000 nm, > 50 µg/ml in H_2O	**716952**
	diam. × L 30 nm × 4,500 nm, > 50 µg/ml in H_2O	**716944**
Nickel(II) oxide	diam. × L ~20 nm × 10 µm, powder	**774545**
Silver	diam. × L 115 nm × 20-50 µm, 0.5wt% in isopropyl alcohol	**739448**
	diam. × L 35 nm × 25 µm, 5 mg/mL in ETH	**807168**
Titanium(IV) oxide	diam. × L ~100 nm × 10 µm, powder	**774510**
Tungsten(VI) oxide	diam. × L ~50 nm × 10 µm, powder	**774537**
Zinc oxide	diam. × L 300 nm × 4-5 µm, powder	**774006**

Gold Nanorods

For a complete list of materials, visit **SigmaAldrich.com/goldnanorods.**

Absorption	Description	Product No.
550 nm	diam. × L 25 nm × 40 nm, dispersion in H_2O	**900366**
650 nm	diam. × L 25 nm × 70 nm, dispersion in H_2O	**900367**
650 nm	diam. × L 25 nm × 60 nm, dispersion in H_2O	**771686**
780 nm	diam. × L 10 nm × 40 nm, dispersion in H_2O	**900362**
780 nm	diam. × L 10 nm × 38 nm, dispersion in H_2O	**716812**
808 nm	diam. × L 10 nm × 41 nm, dispersion in H_2O	**716820**

Graphene and Carbon Nanotubes

Carbon nanomaterials, including nanotubes, graphite, graphene, doped graphene, and composites for a wide range of applications in advanced energy conversion systems, such as solar cells and fuel cells, and energy storage, such as supercapacitors and batteries.

For a complete list of available graphene and carbon nanomaterials, visit **SigmaAldrich.com/graphenetech.**

Carbon Nanotubes

Production Method	Purity	Dimensions	Product No.
Single-Walled Carbon Nanotubes			
CoMoCAT® Catalytic Chemical Vapor Deposition (CVD) Method	>95% (carbon as SWCNT)	0.6-1.1 nm diameter	**775533**
	carbon >90%, ≥80.0% (carbon as SWNT)	0.7-1.4 nm diameter	**724777**
	carbon >90%, ≥70% (carbon as SWNT)	0.7-1.3 nm diameter, 450-2300 nm length	**704113**
Catalytic Carbon Vapor Deposition (CCVD) Method	>70% (TGA)	average diamter 2 nm, 3 µm length	**755710**
Electric Arc Discharge Method	30% (Metallic), 70% (Semiconducting), <3.5% Metal Catalyst	diameter 1.2-1.7 nm, length 0.3-5 µm	**750492**
	30% (Metallic), 70% (Semiconducting), <1% Metal Catalyst	diameter 1.2-1.7 nm, length 0.3-5 µm	**750514**
Multi-Walled Carbon Nanotubes			
Catalytic Carbon Vapor Deposition (CCVD) Method	Metal Oxide <5% TGA	average diameter 9.5 nm, length 1µm	**755117**
	Metal Oxide <5% TGA	average diameter 9.5 nm, length 1.5 µm	**755133**
Chemical Vapor Deposition (CVD) Method	>98% (carbon)	diameter 6-13 nm, length 2.5-20 µm	**698849**
	>90% (carbon)	diameter 110-170 nm, length 5-9 µm	**659258**
Electric Arc Discharge Method	20-30% (MWCNT)	diameter 7-12 nm, length 0.5-10 µm	**406074**
	>7.5% (MWCNT)	diameter 7-15 nm, length 0.5-10 µm	**412988**
CoMoCAT® Catalytic Chemical Vapor Deposition (CVD) Method	>95% (carbon)	diameter 2.5-3 nm, length 2-6 µm	**900788**

Graphite

Particle Size	Product No.
<20 µm	**282863**
<45 µm	**496596**
<150 µm	**496588**

Particle Size	Product No.
-325 mesh (<44 µ, ≥99%)	**808067**
-325 mesh (44 µ, 50-70%)	**808083**
-100 mesh (<150 µ) (80% minimum)	**808091**

Particle Size	Product No.
+50 mesh (300µ, ≥80%)	**808113**
+100 mesh (≥75% min)	**332461**
+200 mesh (75 µ, ≥70%)	**808105**

Graphene

Name	Description	Product No.
Graphene	Highly conductive, electrical conductivity > 10^3 S/m, powder	**900561**
	Hierarchically porous graphene, powder	**900562**
	Silane modified, powder	**900552**
	Alkylamine functionalized, powder	**900551**
Doped Graphene	Nitrogen-doped graphene with high electrochemical activity towards Oxygen Reduction Reaction (ORR) in alkali medium, powder	**900416**
	Nitrogen-doped graphene, surface area >500 m^2/g (BET), powder	**900527**
	Nitrogen/phosphorus co-doped graphene, powder	**900531**
	Nitrogen/sulfur co-doped graphene, powder	**900530**
	Phosphorus-doped graphene, powder	**900529**
	Sulfur-doped graphene, powder	**900528**
	Boron-doped graphene, powder	**900526**
	Boron/nitrogen co-doped graphene, powder	**900535**
Graphene nanoplatelets	Surface area 300 m^2/g	**900394**
	Surface area 500 m^2/g	**900439**
	Surface area 750 m^2/g	**900407**
	Particle size 5 µm, surface area 50 to 80 m^2/g	**900409**
	Particle size 5 µm, surface area 120 to 150 m^2/g	**900412**
	Particle size 15 µm, surface area 50 to 80 m^2/g	**900410**
	Particle size 15 µm, surface area 120 to 150 m^2/g	**900420**
	Particle size 25 µm, surface area 50 to 80 m^2/g	**900411**
	Particle size 25 µm, surface area 120 to 150 m^2/g	**900413**
Graphene nanoplatelet papers	11.5 in. x 23.5 in., thickness 50 µm	**900449**
	11.5 in. x 23.5 in., thickness 120 µm	**900451**
	11.5 in. x 23.5 in., thickness 240 µm	**900452**

Reduced Graphene Oxide

Name	Description	Product No.
Reduced graphene oxide	Chemically reduced, Carbon >75%, Oxygen <22%, powder	**777684**
	Chemically reduced by hydrizine, Carbon >75%, Nitrogen <5%, powder	**805424**

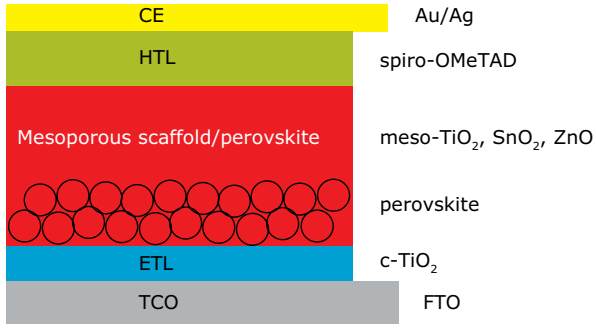
Graphene Nanocomposites

Name	Particle Size	Loading Density	Product No.
Graphene-Based Nanocomposites (10 mg/mL dispersion in acetone; resistance of graphene: <10^3 Ω/sq)			
Pt/graphene nanocomposite	2-5 nm (Pt nanocrystal)	5%-30% (Pt nanocrystal) by TEM	**803693**
Pd/graphene nanocomposite	5-50 nm (Pd nanocrystal)	10%-50% (Pd nanocrystal) by TEM	**803707**
PtPd/graphene nanocomposite	5-50 nm (PtPd nanocrystal)	10%-50% (PtPd nanocrystal) by TEM	**803758**
PtCo/graphene nanocomposite	2-5 nm (PtCo nanocrystal)	10%-50% (PtCo nanocrystal) by TEM	**803766**
Fe_3O_4/graphene nanocomposite	5-25 nm (Fe_3O_4 nanocrystal)	30%-70% (Fe_3O_4 nanocrystal) by TEM	**803715**
Mn_3O_4/graphene nanocomposite	5-25 nm (Mn_3O_4 nanocrystal)	30%-70% (Mn_3O_4 nanocrystal) by TEM	**803723**
TiO_2/graphene nanocomposite	10-40 nm (TiO_2 nanocrystal)	30%-70% (TiO_2 nanocrystal) by TEM	**805351**
Reduced Graphene Oxide-Based Nanocomposites (10 mg/mL dispersion in acetone; resistance of reduced graphene oxide: <10^3 Ω/sq)			
Pt/reduced graphene oxide nanocomposite	2-5 nm (Pt nanocrystal)	5%-30% (Pt nanocrystal) by TEM	**803693**
Pd/reduced graphene oxide nanocomposite	5-50 nm (Pd nanocrystal)	10%-50% (Pd nanocrystal) by TEM	**803707**
PtPd/reduced graphene oxide nanocomposite	5-50 nm (PtPd nanocrystal)	10%-50% (PtPd nanocrystal) by TEM	**803758**
PtCo/reduced graphene oxide nanocomposite	2-5 nm (PtCo nanocrystal)	10%-50% (PtCo nanocrystal) by TEM	**803766**
Fe_3O_4/reduced graphene oxide nanocomposite	5-25 nm (Fe_3O_4 nanocrystal)	30%-70% (Fe_3O_4 nanocrystal) by TEM	**803715**
Mn_3O_4/reduced graphene oxide nanocomposite	5-25 nm (Mn_3O_4 nanocrystal)	30%-70% (Mn_3O_4 nanocrystal) by TEM	**803723**
TiO_2/reduced graphene oxide nanocomposite	10-40 nm (TiO_2 nanocrystal)	30%-70% (TiO_2 nanocrystal) by TEM	**805343**

Perovskite Materials for Solar Cells

Organolead-halide-based perovskite materials exhibit high photon conversion efficiency and find applications as photosensitizers in solar cells.

For a complete list of available materials, visit **SigmaAldrich.com/perovskites.**



Perovskite Ink

Deposit perovskites in one step.

Name	Description	Product No.
Methylammonium lead triiodide precursor ink	DMF-based, ready-to-use solution for depositing $CH_3NH_3PbI_3$	**900709**

Precursors

Used for synthesis of mixed organic-cation/anion perovskites with optimized band gap, carrier diffusion length, and power conversion efficiency.

Organohalides

Name	Composition	Description	Product No.
n-Butylammonium Iodide	C_4H1_2NI	Powder	**805874**
Formamidinium Iodide	$CH5N_2I$	Powder	**806048**
Guanidinium Iodide	CH_6N_3I	Powder	**806056**
Methylammonium iodide	CH_6NI	Powder	**793493**
Methylammonium iodide	CH_6NI	Solution, 0.42 M in 2-propanol	**808431**
Methylammonium bromide	CH_6NBr	Powder	**793507**

Lead Halides

Name	Description	Product No.
Lead(II) iodide	99.999% trace metals basis, perovskite grade	**900168**
Lead(II) iodide solution	0.55 M in DMF	**795550**
Lead(II) bromide	99.999% trace metals basis	**398853**
Lead(II) chloride	99.999% trace metals basis, −10 mesh, anhydrous beads	**449865**

Titania Nanomaterials

For depositing porous titania films.

Name	Description	Product No.
Titanium dioxide	18 nm, nanocrystalline colloidal paste for transparent film	**798509**
	22 nm, nanocrystalline colloidal paste for transparent film	**798495**
	colloidal paste for opaque film	**798517**

Hole Transport Materials (HTMs)

Name	Description	Product No.
Spiro-MeOTAD	99% (HPLC)	**792071**
H101	>98%	**804894**
PTAA	Average Mn >10,000	**900955**
	Average Mn 7,000-10,000	**702471**
P3HT, regioregular	Mw 25,000-45,000	**900563**
	Mw 50,000-75,000	**900550**
	Mw 85,000-100,000	**900549**
	Product of Rieke Metals, Inc	**445703**
PEDOT:PSS dispersion in H_2O	Dry re-dispersible pellets, high conductivity	**900208**
	Dry re-dispersible pellets	**768618**
	0.5-1.0%, high-conductivity grade	**900181**
	1.0%, high-conductivity grade	**768642**
	1.1%, high-conductivity grade, surfactant-free	**739332**
	1.1%, high-conductivity grade, neutral pH	**739324**
	1.3 wt% dispersion in H_2O, conductive grade,	**483095**
	2.8 wt% dispersion in H_2O, low-conductivity grade	**560596**
Copper(I) thiocyanate (CuSCN)	99%	**298212**
Copper(II) phthalocyanine (CuPc)	Dye content, >99%	**546682**
	Sublimed grade, Dye content 99%,	**546674**
	Triple-sublimed grade, >99.95% trace metals basis,	**702854**

Hole Conductor Cobalt Dopants

Name	Purity	Product No.
FK 102 Co(II) PF_6 salt	98%	**805238**
FK 102 Co(II) TFSI salt	98%	**805246**
FK 102 Co(III) PF_6 salt	>98%	**805254**
FK 102 Co(III) TFSI salt	98%	**805203**
FK 209 Co(II) PF_6 salt	98%	**805378**
FK 209 Co(II) TFSI salt	98%	**805386**
FK 209 Co(III) PF_6 salt	98%	**805408**
FK 209 Co(III) TFSI salt	98%	**805394**
FK 269 Co(II) PF_6 salt	98%	**805548**
FK 269 Co(II) TFSI salt	98%	**805815**
FK 269 Co(III) PF_6 salt	98%	**805521**
FK 269 Co(III) TFSI salt	98%	**805807**

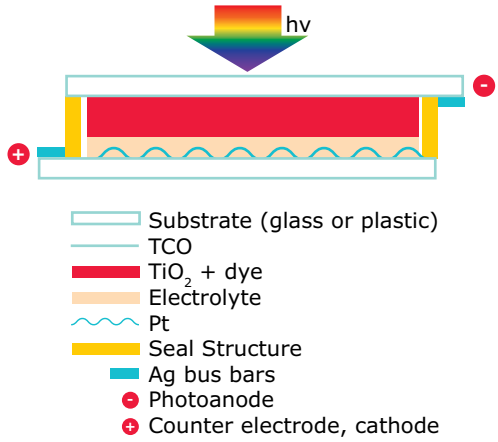
Fluorine-Doped Tin Oxide (FTO) Coated Glass

Surface Resistivity (ohm/sq)	Transmittance (% visible)	Haze (%)	L x W x D (mm)	Product No.
7	80-82	5	50 x 50 x 2.2	**735140**
			100 x 100 x 2.3	**735159**
			300 x 300 x 2	**735167**
8	80-81.5	12	50 x 50 x 2.2	**735175**
			100 x 100 x 2.3	**735183**
			300 x 300 x 2	**735191**
10	83	1	50 x 50 x 2.2	**735205**
			100 x 100 x 2.3	**735213**
			300 x 300 x 2	**735221**
13	82-84.5	≤0.74	50 x 50 x 2.2	**735248**
			100 x 100 x 2.3	**735256**
			300 x 300 x 2	**735264**

Materials for Dye-Sensitized Solar Cells

Metal and metal-free dyes and nanoparticle-based pastes for use in dye-sensitized solar cells (DSSC).

For a complete list of available materials, visit **SigmaAldrich.com/dssc.**



Metal Complex Dyes

Name	Product No.
C101 dye	**791423**
C106 dye	**791393**
K19 dye	**791415**
N3 dye	**703206**
N719 dye	**703214**
N747 black dye	**791245**
Z907 dye	**703168**

Metal-Free Dyes

Name	Product No.
Coumarin 102	**546151**
Coumarin 153	**546186**
Coumarin 30	**546127**
Coumarin 6	**546283**
D102 dye	**745944**
D149 dye	**736015**
D205 dye	**745618**
D358 dye	**746606**
HB194	**747211**
Merocyanine 540	**323756**
MK-2 dye	**728705**

Nanoparticle Pastes

Name	Description	Product No.
Silver paste	Screen printable, resistivity 30-35 μΩ-cm	**791903**
	Screen printable, resistivity 9-10 μΩ-cm	**791881**
	Screen printable, resistivity 5-6 μΩ-cm	**791873**
Titania paste	Transparent	**791547**
	Active opaque	**791555**
	Reflector	**791539**
Platinum paste	Screen printable	**791512**

Organic Photovoltaic (OPV) Donors and Acceptors

Polymer and small organic donor materials and fullerene/nonfullerene acceptors for use in high-performance organic solar cells. For a complete list of available materials, visit **SigmaAldrich.com/opv.**

Donor Materials

Category	Name	Product No.
Polymer Donors	PffBT4T-2OD (PCE-11)	**900720**
	PffBT4T-C9C13	**900980**
	PTB7-Th (PCE-10)	**794333**
	PTB7	**772410**
	PBTTT-C14	**753971**
	PCPDTBT	**754005**
	PDPP2T-TT-OD	**791989**
	PCDTBT	**753998**
	TQ1	**745898**
	PFO-DBT, AVERAGE MOL WT 10,000-50,000	**754013**
	PBDTTT-CF	**772402**
	PBDT(EH)-TPD(Oct)	**773514**
	PBTTPD	**745901**
Small Molecule Donors	2,4-Bis[4-(N,N-diphenylamino)-2,6-dihydroxyphenyl]squaraine	**757233**
	2,4-Bis[4-(N,N-diisobutylamino)-2,6-dihydroxyphenyl] squaraine	**758337**
	2,4-Bis[4-(N,N-dibenzylamino)-2,6-dihydroxyphenyl]squaraine	**757268**
	DTDCTB	**777293**
	DTDCPB	**777048**
	DPDCPB	**790524**
	DTS($FBTTH_2$)$_2$	**772380**
	DTS($PTTH_2$)$_2$	**772372**

Non Fullerene Acceptors

Name	Product No.
N2200 (P(NDI2OD-T2))	**900961**
N2300	**900962**
ITIC	**900799**
ITIC-Th	**900800**
IT-DM	**900803**
IT-M	**900947**
EH-IDTBR	**900853**
O-IDTRB	**900810**
FBR	**900854**
di-PDI	**900774**
SF-PDI	**900782**

Fullerene Acceptors

Name	Purity	Product No.
[5,6]-Fullerene C60	Sublimed, 99.9%	**572500**
	99.50%	**379646**
	98%	**483036**
[5,6]-Fullerene-C70	≥99%	**709476**
	98%	**482994**
PC60BM	>99.9%	**684457**
	>99.5%	**684449**
	>99%	**684430**
PC70BM	99%, mixture of isomers	**684465**
ICMA, indene-C60 monoadduct	97%	**753947**
ICBA, indene-C60 bisadduct	99%	**753955**

Quantum Dots

Quantum dots exhibit excellent photo- and electro-luminescent properties such as narrow emission bandwidth and high brightness, rendering them suitable for applications in solar cells, light emitting diodes, photodetectors, and liquid-based crystal displays.

For a complete list of available materials, visit **SigmaAldrich.com/quantumdots.**

PbS Quantum Dots

Used in tandem and multijunction solar cells, photodetectors, and infrared light-emitting diodes.

Name	Emission wavelength	Description	Product No.
PbS core-type quantum dots	900 nm	10 mg/mL in toluene; oleic acid coated	**900733**
	1000 nm	10 mg/mL in toluene; oleic acid coated	**747017**
	1100 nm	10 mg/mL in toluene; oleic acid coated	**900735**
	1200 nm	10 mg/mL in toluene; oleic acid coated	**747025**
	1300 nm	10 mg/mL in toluene; oleic acid coated	**900737**
	1400 nm	10 mg/mL in toluene; oleic acid coated	**747076**
	1500 nm	10 mg/mL in toluene; oleic acid coated	**900728**
	1600 nm	10 mg/mL in toluene; oleic acid coated	**747084**

Perovskite Quantum Dots

For applications in backlighting in liquid crystal displays, light-emitting diodes, and photodetectors.

Name	Emission wavelength	Description	Product No.
$CsPb(Cl,Br)_3$-based perovskite quantum dots	450 nm	10 mg/mL in toluene; oleic acid and oleylamine coated	**900748**
	480 nm	10 mg/mL in toluene; oleic acid and oleylamine coated	**900747**
	510 nm	10 mg/mL in toluene; oleic acid and oleylamine coated	**900746**

InP-based Quantum Dots

For light-emitting diodes and backlighting in liquid crystal displays.

Name	Emission wavelength	Description	Product No.
InP/ZnS quantum dots	550 nm	5 mg/mL in toluene stablized with oleylamine ligands	**776750**
	560 nm	5 mg/mL in toluene stablized with oleylamine ligands	**776793**
	590 nm	5 mg/mL in toluene stablized with oleylamine ligands	**776769**
	620 nm	5 mg/mL in toluene stablized with oleylamine ligands	**776777**
	650 nm	5 mg/mL in toluene stablized with oleylamine ligands	**776785**

Cd-Based Quantum Dots

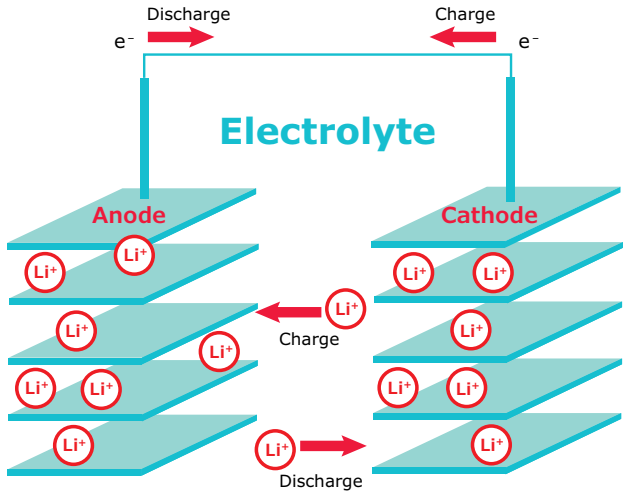
Used in solar cells, light-emitting diodes, and backlighting in liquid crystal displays.

Name	Emission wavelength	Description	Product No.
CdS/ZnS core-shell type quantum dots	400 nm	5 mg/mL in toluene; oleic acid coated	**900286**
	425 nm	5 mg/mL in toluene; oleic acid coated	**900333**
	450 nm	5 mg/mL in toluene; oleic acid coated	**900334**
CdSe/ZnS core-shell type quantum dots	520 nm	5 mg/mL in toluene stabilized with octadecylamine ligands	**900214**
	540 nm	5 mg/mL in toluene stabilized with octadecylamine ligands	**900215**
	560 nm	5 mg/mL in toluene stabilized with octadecylamine ligands	**900216**
	580 nm	5 mg/mL in toluene stabilized with octadecylamine ligands	**900217**
	620 nm	5 mg/mL in toluene stabilized with octadecylamine ligands	**900219**
CdSe/CdS core-shell type quantum rods	530 nm	5 mg/mL in hexane	**900511**
	560 nm	5 mg/mL in hexane	**900512**
	590 nm	5 mg/mL in hexane	**900515**
	620 nm	5 mg/mL in hexane	**900514**
CdTe core-type quantum dots	510 nm	COOH functionalized, powder	**777986**
	520 nm	COOH functionalized, powder	**777935**
	570 nm	COOH functionalized, powder	**777943**
	610 nm	COOH functionalized, powder	**777951**
	710 nm	COOH functionalized, powder	**777978**

Lithium-Ion Battery Materials

Applications of lithium-ion batteries (LIBs) extend from modern electronics to automobiles. Battery-grade materials with low water and acid content allow the fabrication of batteries with enhanced electrochemical propeties.

For a complete list of available materials, visit **SigmaAldrich.com/lib.**



Electrolyte Solutions

Lithium Hexafluorophosphate Solutions, Battery Grade: H_2O <50

Name	Description	Product No.
2.0 M $LiPF_6$ in EC/DMC=50/50 (v/v)	in ethylene carbonate and dimethyl carbonate	**809357**
2.0 M $LiPF_6$ in EC/DEC=50/50 (v/v)	in ethylene carbonate and diethyl carbonate	**809349**
2.0 M $LiPF_6$ in EC/EMC=50/50 (v/v)	in ethylene carbonate and ethyl methyl carbonate	**809365**
2.0 M $LiPF_6$ in EMC	in ethyl methyl carbonate	**809403**
2.0 M $LiPF_6$ in DMC	in dimethyl carbonate	**809543**
2.0 M $LiPF_6$ in DEC	in diethyl carbonate	**809543**
2.0 M $LiPF_6$ in PC	in propylene carbonate	**809470**

Cathode Materials

Name	Composition	Description	Product No.
Lithium iron(II) phosphate, LFP	$LiFePO_4$	powder, particle size <5 µm (BET), >97%	**759546**
Lithium manganese oxide, LMO	$LiMn_2O_4$	spinel, powder, particle size <0.5 µm (BET), >99%	**725129**
Lithium manganese nickel oxide, LMNO	$Li_2Mn_3NiO_8$	powder, particle size <0.5 µm (BET), >99%	**725110**
Lithium nickel manganese cobalt oxide, NMC	$LiNi_{0.33}Mn_{0.33}Co_{0.33}O_2$	powder, particle size <0.5 µm (BET), >98%	**761001**
Lithium nickel dioxide, LNO	$LiNiO_2$	powder, <3 µm particle size (BET), ≥98% trace metals basis	**757365**
Lithium cobalt(III) oxide	$LiCoO_2$	powder, 99.8% trace metals basis	**442704**
Lithium cobalt phosphate, LCP	$LiCoPO_4$	powder, 99%	**725145**

Anode Materials

Name	Composition	Description	Product No.
Lithium titanate, LTO	$Li_4Ti_5O_{12}$	spinel, nanopowder, particle size <200 nm (BET), >99%	**702277**
Lithium, granular	Li	particle size 4-10 mesh, 99%, metals basis	**444456**
Lithium, ribbon	Li	thickness × W 0.38 × 23 mm, 99.9% trace metals basis	**265985**
		thickness × W 0.75 × 45 mm, 99.9% trace metals basis	**265993**
		thickness × W 0.75 × 19 mm, 99.9% trace metals basis	**320080**
		thickness × W 1.5 × 100 mm, 99.9% trace metals basis	**266000**
Tin(IV) oxide	SnO_2	nanopowder, <100 nm particle size (BET)	**549657**

Electrode Sheets

Name	Composition	Description	Product No.
Lithium nickel manganese cobalt oxide	$LiNi_{0.33}Mn_{0.33}Co_{0.33}O_2$	aluminum substrate, size 5 in. × 10 in., loading >80%, thickness 25-50 µm	**765163**
Lithium nickel cobalt aluminum oxide	$LiNi_{0.8}Co_{0.15}Al_{0.05}O_2$	aluminum substrate, size 5 in. × 10 in., loading >80%, thickness 12-25 µm	**765171**
Lithium manganese nickel oxide	$Li_2Mn_3NiO_8$	aluminum substrate, size 5 in. × 10 in., loading >80%, thickness 25-50 µm	**765198**
Lithium manganese oxide	$LiMn_2O_4$	aluminum substrate, size 5 in. × 10 in., loading >80%, thickness 25-40 µm	**765201**
Lithium titanate spinel	$Li_4Ti_5O_{12}$	aluminum substrate, size 5 in. × 10 in., loading >80%, thickness 25-50 µm	**765155**

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