



Avantama AG – Product overview

Inks for charge selective layers in printed electronics
(OPV, OPD, perovskite PV, OLED)

Testimonials from active material suppliers



“Avantama charge transport materials allow the production of fully printed OPD devices showing impressive performances.”

Dr. Phoebe Tan, CEO



“Our OPV research test devices showed great performance when using Avantama charge transport materials.”

Dr. Henning Richter, VP, Research and Development



“Avantama charge transport materials show great performances with a broad range of our active materials.”

Dr. Philippe Berrouard, CTO

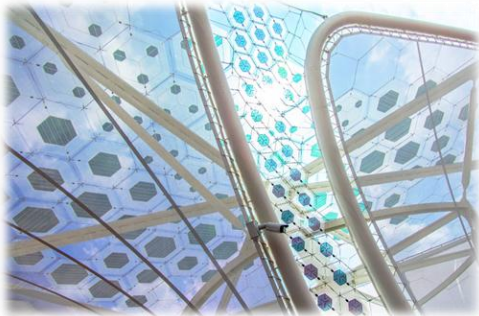
About Avantama AG

- Based near Zurich, Switzerland
- 30 employees
- 180+ patents
- High-margin nanomaterials for electronics
 - Solar cells / OPD (metal oxide formulations)
 - Displays (perovskite quantum dots)
 - Other applications
 - Audited materials supplier to the electronics industry since 2016
 - Multi-ton production facility in Switzerland



Application overview

Printable charge selective inks



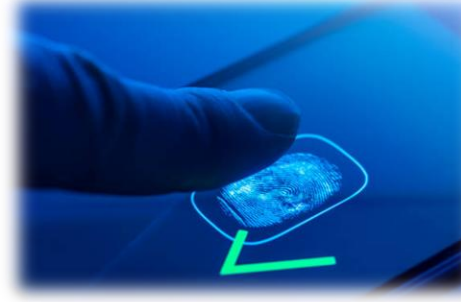
<https://www.ke-next.de/panorama/die-expo-in-mailand-zeigt-die-potenziale-der-opv-technologie-103.html>

OPV/PSC outdoor



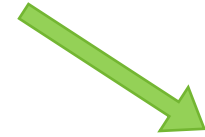
<https://www.epishine.com/applications>

OPV/PSC indoor



<https://www.gettyimages.ch/fotos/fingerprint-detector>

OPD



others..
- OLED
- detectors

Advantages of Avantama inks

Issues of classic charge selective layers:

Vacuum deposition (high costs)

High deposition temperature
(limited to rigid substrates)

Toxic and/or aggressive solvents

Poor «customization» possibilities
of functional material



Avantama charge selective inks:

Solution processable

Compatible with flexible substrates
(drying <120°C)

Formulations in green solvents

Customer-specific formulation
adjustment on request

Benefits and applications of Avantama inkjet formulations

Benefits

Compatible with most **DOD**
printheads

Compatible with a wide range of
active materials

Compatible with **flexible** substrates
(drying $<120^{\circ}\text{C}$)

Formulations in **green** solvents

No nozzle clogging

Applications

Indoor and outdoor **OPV**

Indoor and outdoor **PSC**

Organic photodetectors (**OPD**)

Inorganic photodetectors (**SWIR**)

Product overview: ETL

Function	Product name	NP type	Solid loading [wt%]	Solvent	Viscosity [cP]	Suitable coating methods		
						Spin-coating	Slot-die	Inkjet
ETL	N-10 (#6038)	ZnO	2.5	Isopropanol	2.4	✓		
	N-10-Flex (#12073)			Butanols	2.8		✓	
	N-10-Inkjet (#15030)			Hexanol	4.5			✓
	N-11 (#7027)			Isopropanol	2.1	✓		
	N-11-Flex (#10021)			Butanols	2.9		✓	
	N-12 (#7022)		5.0	Ethanol	1.2	✓		
	N-13 (#9010)		20.0	Ethanol	1.8	✓		
	N-20X-Flex (#10022)	AZO	2.5	Butanols	3.0		✓	
	N-21X (#8046)			Isopropanol	2.2	✓		
	N-21X-Flex (#10023)			Butanols	3.0		✓	
	N-21X-Inkjet (#15016)			Hexanol	4.6			✓



Product overview: ETL

Function	Product name	NP type	Solid loading [wt%]	Solvent	Viscosity [cP]	Suitable coating methods		
						Spin-coating	Slot-die	Inkjet
	N-30 (#9075)	SnO2	2.5	Butanols	3.5		✓	
	N-31 (#9076)			Butanols	3.2		✓	
	N-31-Inkjet (#15031)			Hexanol	4.9			✓
	N-33 (#13025)			Butanols	3.2		✓	

✓ = recommended coating method



Product overview: HTL

Function	Product name	NP type	Solid loading [wt%]	Solvent	Viscosity [cP]	Suitable coating methods		
						Spin-coating	Slot-die	Inkjet
HTL	P-10 (#6040)	W03	2.5	Isopropanol	2.0	✓		
	P-21 (#10128)	NiO	2.5	Ethanol	1.3	✓		
	P-40 (#10095)	ATO	2.5	Butanols	3.0	✓	✓	

✓ = recommended coating method



Avantama ink recommendation for OPV (indoor)

Overcoming the need for UV-light activation

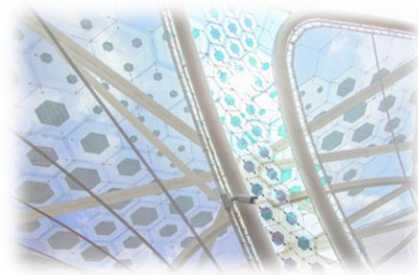


Active layer	Avantama formulation applied	Achievements	Publication
PV2001:PCBM	N-12 (ZnO), N-31 (SnO₂)	Fully printed cells with silver grid	10.1088/2058-8585/ab6e73
P3HT:PC61BM	N-10 (ZnO)	Allowing a new production process	10.1002/aelm.201700325
BDT-2T-1D:PNP	N-10 (ZnO)	PCE=12.3% under 200 lux	10.1021/acsami.9b00018

Please contact our distributor to obtain a personalized and more detailed recommendation.

Avantama ink recommendation for OPV (outdoor)

Improving module long-term stability

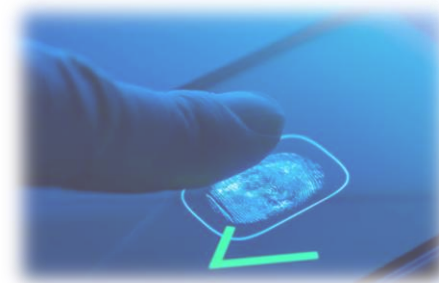


Active layer	Avantama formulation applied	Achievements	Publication
PM6:Y6	N-10 (ZnO)	High performance semi-transparent OPV	10.1021/acsaem.1c03017
PM6:IT-4F	N-30 (SnO2)	Improved compatibility with non-fullerene materials	10.1039/c9mh00379g
P3HT:IDTBR	ZnO	Large scale modules	10.1039/c8ee01150h

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Avantama ink recommendation for OPD

Allowing large area OPD sensors

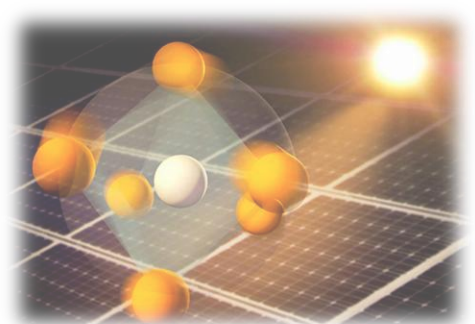


Active layer	Avantama formulation applied	Achievements	Publication
P3HT:O-IDTBR	N-31	Inkjet printed OPD	10.1021/acsaelm.1c00760
PD-940 (Raynergy)	N-21X-Flex, P-22	Fully printed OPD beyond 1000nm	10.1002/adom.202101723
PIF:IDFBR PIF:ITIC-4F	N-10	Printed wavelength-selective OPD	10.1002/adma.201908258

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Avantama ink recommendation for PSC

Allowing fully solution-processed PSC



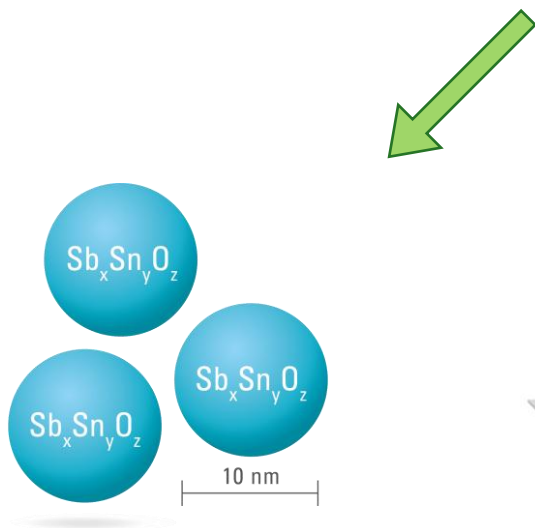
<https://www.theengineer.co.uk/perovskite-solar-cells/>

Active layer	Avantama formulation applied	Achievements	Publication
MAPbI ₃	Nb:TiO₂	Fill factor reaching 83%	10.1039/c9ee02202c
MAPbI ₃	AZO, NiO	High performance (PCE=19.1%) printed PSC	10.1002/adfm.202004273
CsPbI _x Br _{3-x}	ZnO	Enabling moisture-stable PSC	10.1002/adfm.202106233

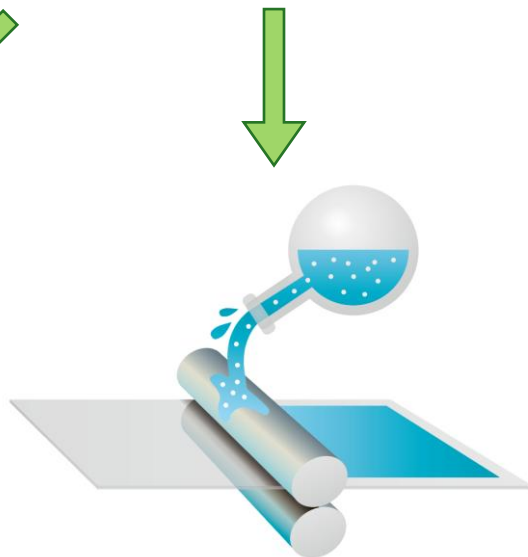
Please contact our distributor to obtain a personalized and more detailed recommendation.

Need formulation adjustment for your application?

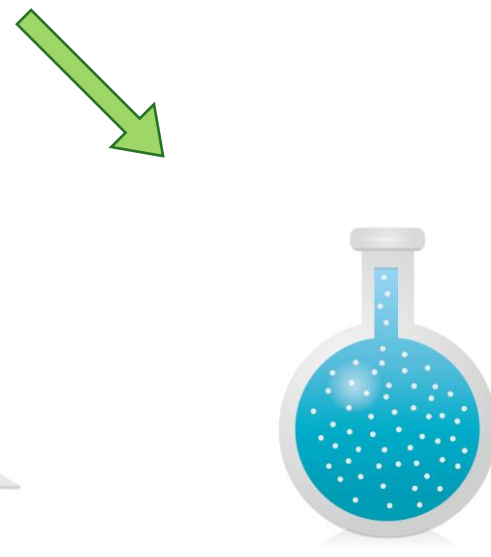
Avantama offers customization of metal oxide inks



Customization of metal oxide
nanoparticle composition

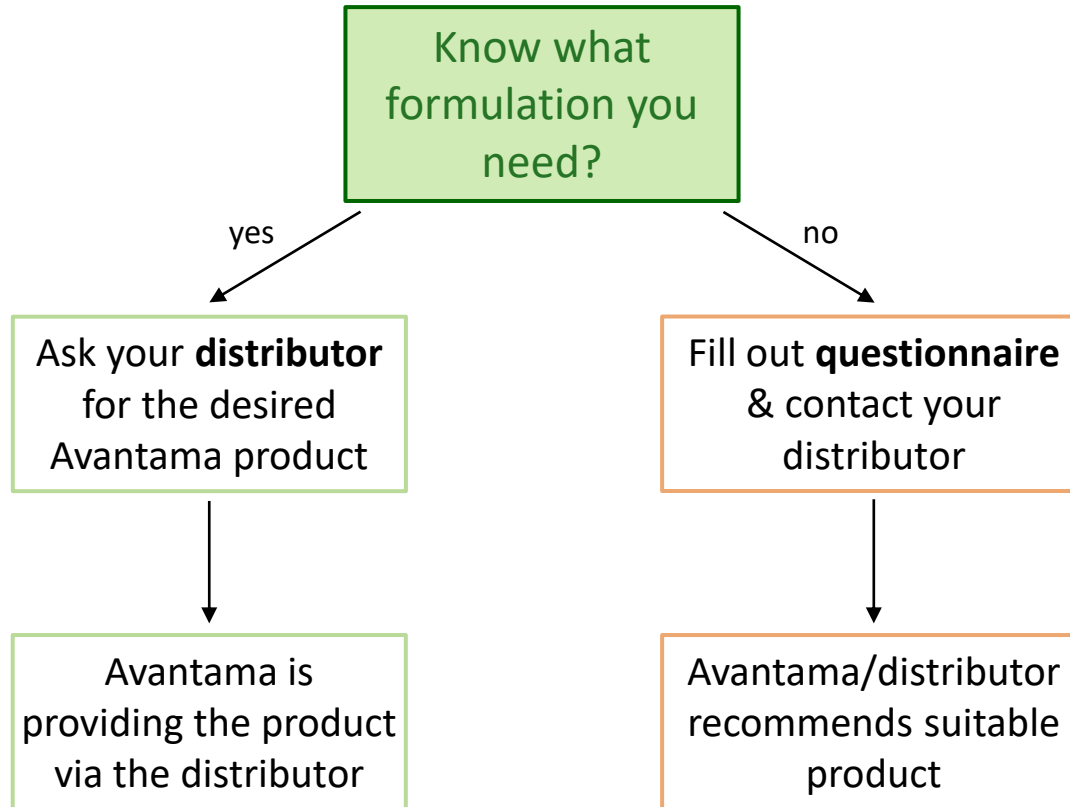


Adjustment of **solvent**
system / printing properties



Customization of
formulation properties

How to select the suitable product for your application?



Product questionnaire

What are your requirements for the metal oxide nanoparticle formulation?

- Particles composition: _____
- Printing method: _____
- Targeted layer thickness: _____
- Application: _____
- Further requirements: _____

Contact:

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