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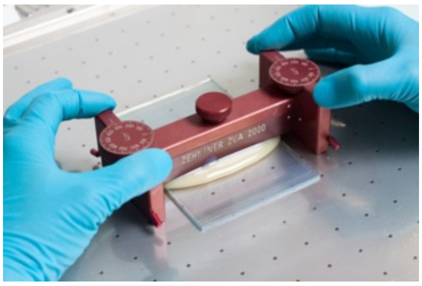
SOLARONIX

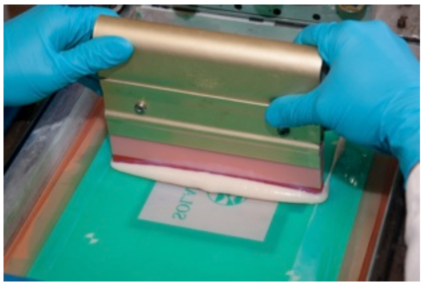
Ti–Nanoxide HT/SP

Screen-Printing Transparent Nanocrystalline Titanium Dioxide

For industry or researchers and industries who manufacture or study Dye Solar Cells, Ti-Nanoxide HT/SP is a screen-printing paste which provides a highly transparent titania layer with a large surface area after sintering.

Unlike other titania that is supplied in powder form, Ti–Nanoxide HT/SP is ready to be printed and doesn't require any processing before use. Our product is high quality and tested in real solar cells.





Characteristics

Intended for	screen-printing, slot-coating (doctor blade)
Aspect	light-yellow viscous paste
Resulting Layer	highly transparent (after firing)
Crystallinity	100% anatase
Pore Size	10-15 nm
Diffusing Particles	*none*
Concentration	~18% wt.
Medium	terpineol, organic binders
Surface Area	~100 m^2/g (after firing)
HS Code	2823.0000

Retail Quantities

10 g	ref.	14711
20 g	ref.	14721
50 g	ref.	14751
100 g	ref.	14712
200 g	ref.	14722
500 g	ref.	14742
1 kg	ref.	14713

Pricing on product page:
solx.ch/tinanohtsp

How to Order

Please visit our webshop at shop.solaronix.com, or send us an e-mail or fax indicating your desired products.

Bulk Supply

In addition to the retail quantities listed above, Ti–Nanoxide HT/SP is also available in bulk for industrial purpose. Please inquire.

USAGE

Ti–Nanoxide HT/SP is a screen printing paste that is transformed into a porous nanocrystalline film of TiO_2 by firing at 450-500°C. This porous film provides an extremely high surface are, ca. 1000 times greater than the geometric surface area, and is ideal for adsorbing a monolayer of sensitizing dye molecules.

The task of the film is to host the dye molecules and provide a pathway for electron transfer from the photo-excited dye molecules to the conductive substrate.

Printing Procedure For Titania Electrodes

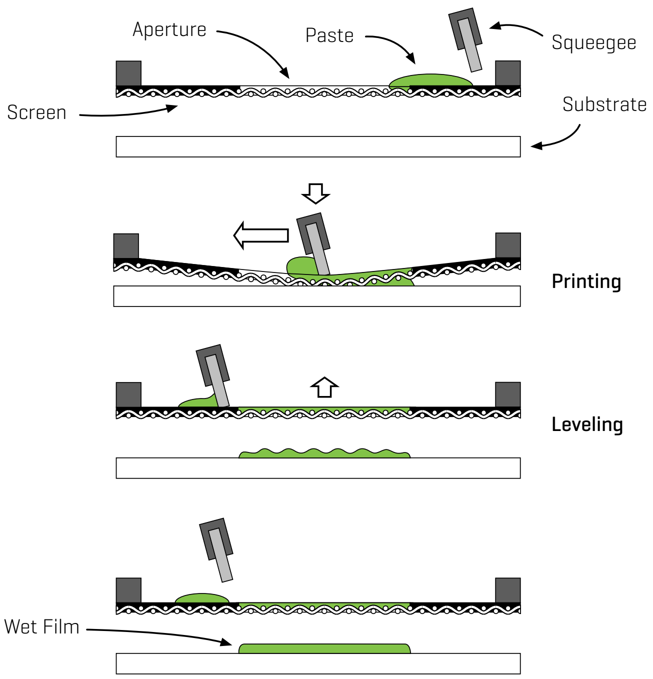
Stir the paste well before using for an even deposition. Place an excess of paste at the top of the screen and use it to wet the squeegee.

Place the squeegee behind the paste and press down with enough pressure to bring the screen into contact with the substrate and bend the soft part of the squeegee.

With a smooth movement, and maintaining even pressure, pull the squeegee from the top to the bottom of the screen.

The paste is forced through the fine mesh of the printable area of the screen and deposited onto the substrate.

> *Make sure to use enough Ti-Nanoxide HT/SP to complete your deposition in one pass.*



Schematic representation of the screen-printing process

The diameter of the threads and the thread count of the mesh dictates how much of the paste is deposited onto the conductive glass substrate.

> *A 61-64 mesh (61 threads/cm, 64 µm thread diameter) leads to 4 µm thick layers after firing. A 43-80 mesh yields an 8 µm thick layer after firing.*

When printing multiple layers for a thick final layer it is necessary to dry the paste between each successive printing. Simply warm the substrate to 120°C and wait for the solvent to evaporate completely, about 5 minutes. Allow the substrate to return to room temperature before the next print.

> *To improve adhesion and obtain a more aesthetically pleasing layer, let the paste self level for several minutes before drying or firing.*

Sintering Procedure For Titania Electrodes

It is necessary to fire the titania layer to remove the organic screen printing vehicle and to enhance electron transport. Heat the substrate to 475°C with a slow temperature ramp, ca. 30°C per minute. Maintain 475°C for at least 30 minutes to ensure complete combustion and removal of the organic content. Turn off the heat source and let the substrate cool to < 100°C. Attempting to move the substrates while the temperature is >200°C may result in thermal shock and shattering.

> *It is best to fire the titania electrodes just before staining so they don't adsorb ambient moisture. Submerse them in the staining bath while still warm, around 50-60°C. Mesoporous titania electrodes are easily contaminated by volatile substances.*

Common Pitfalls

A cracked or flaked off titania layer indicates poor adhesion. Try decreasing the thickness of your printed titania layer(s). Typically you should be able to stack printed layers up to 12 microns thick without problems.

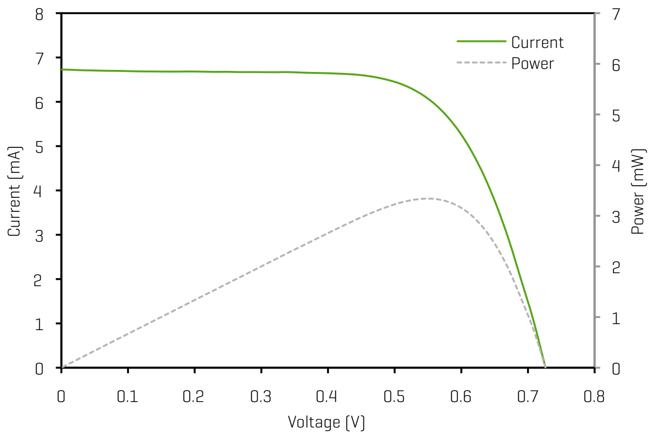
A yellow titania layer indicates insufficient firing or contamination. Try to fire the electrode again at high temperatures (450-500°C)

EXAMPLE

A Dye Solar Cell Fabricated With Ti–Nanoxide HT/SP

A 36 mm^2 titania photo-anode was prepared with 3 printed layers of Ti–Nanoxide T/SP and 1 printed layer of Ti–Nanoxide R/SP on a TCO22–7 glass substrate that was pre-treated with $TiCl_4$. The electrode was fired at 475°C and post treated with $TiCl_4$. After cooling to about 60°C the electrode was stained in a solution of Ruthenizer 535–bisTBA with chenodeoxycholic acid (1:10)as a co-adsorbent. A platinum coated cathode was prepared on another TCO22-7 substrate with a layer of Platisol T. The two electrodes were laminated together using Meltonix 1170–60, and the solar cell was filled with Iodolyte HI–30 through a hole in the cathode. The filling hole was then sealed with Meltonix 1170-60 and a thin glass circle of 6 mm diameter.

The resulting solar cell was placed under 1 sun illumination using a Solaronix Solixon Class-A solar simulator, and equipped with an adequate mask to avoid over-illumination, yielding the following current-voltage curve and tabulated results.



V_{oc}	726 mV	FF	0.68
J_{sc}	18.68 mA/cm^2	Eff.	9.3 %

STORAGE AND SAFETY

Storage

Store the product in its original container, upright and tightly sealed. Keep in a dry place at room temperature, away from light.

The product is not known to suffer from degradation when stored properly. Consider filling the container with inert gas for very long term storage.

While in use, avoid leaving the container open unnecessarily.

Safety

Ti–Nanoxide HT/SP is for research and development use only, and to be manipulated by adequately trained personnel. Ensure good ventilation of the workplace, and wear suitable protective equipment.

Signal word: Warning

For a complete description of safety measures, please refer to the Material Safety Datasheet (MSDS) of Ti–Nanoxide HT/SP.

solaronix.com/msds/

RELATED PRODUCTS

Cited in This Document

- Ti–Nanoxide R/SP, reflective titania paste.
- TCO22–7, 7 ohm/sq. FTO coated glass substrate.
- Chenodeoxycholic Acid, staining additive.
- Ruthenizer 535–bisTBA, ruthenium photo-sensitizer.
- Platisol T, platinum precursor paint.
- Iodolyte HI–30, very high performance electrolyte.
- Meltonix 1170–60, hot-melt sealing film.
- Solixon, continuous illumination solar simulator.

Consider Also

- Ti-Nanoxide T/SP, transparent titania paste.
- Ti-Nanoxide D/SP, opaque titania paste.
- Ti-Nanoxide MC/SP, high porosity titania paste.
- Labware: Staining Boxes, Plastic Tweezers

REFERENCES

Articles About Titania Films

For further reading, have a look at the following articles:

- Physica E, 2002, 197-202
- J. Phys. Chem. B, 2003, 107, 1370–1375 [doi:10.1021/jp026442+]
- J. Mater. Chem. 2004, 14, 2917–2921 [doi:10.1039/B406286H]
- Coord. Chem. Rev. 2004, 248, 1381-1389 [doi:10.1016/j.ccr.2004.03.006]
- Solar Energy Materials & Solar Cells 2009, 93, 379-381 [doi:10.1016/j.solmat.2008.11.012]
- Thin Solid Film, 2011, 519, 6598-6604 [doi:10.1016/j.tsf.2011.04.171]
- Materials Letters 2012, 69, 59-62 [doi:10.1016/j.matlet.2011.11.067]

People Using Ti–Nanoxide HT/SP

A random selection of publications using Ti–Nanoxide HT/SP:

- Prog. Photovolt. Res. Appl. 2009, 17, 265–272 [doi:10.1002/pip.872]
- Solar Energy 2009, 83, 2217-2222 [doi:10.1016/j.solener.2009.09.003]
- Nanocon, 2010, 12-14.pdf
- Applied Energy 2012, 90, 305-308 [doi:10.1016/j.apenergy.2011.03.037]
- Electrochemica Acta 2013, 103, 231-236 [doi:10.1016/j.electacta.2013.04.016]
- Thin Solid Films 2013, in press [doi:10.1016/j.tsf.2013.05.058]
- Thin Solid Films 2013, in press [doi:10.1016/j.tsf.2013.04.096]

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