Solaronix SA
Rue de l'Ouriette 129
CH-1170 Aubonne
Switzerland

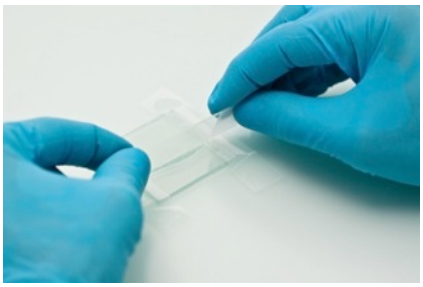
www.solaronix.com
T +41 21 821 22 80
F +41 21 821 22 89
info@solaronix.com

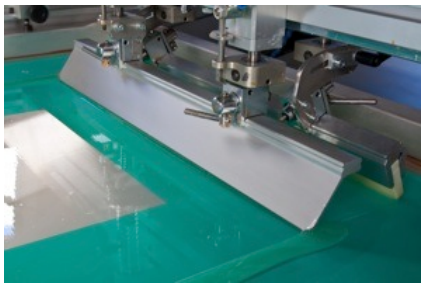
Platisol T/SP

Platinum Catalyst Precursor Paste

Platisol T/SP is a paste containing a platinum precursor which forms a quasi-invisible catalytic layer of platinum by heat treatment.

The formulation of Platisol T/SP makes it specifically adapted to the fabrication of platinum coated electrodes for Dye Solar Cells by slot-coating or by screen-printing.





Characteristics

Intended For	screen-printing, doctor-blading/slot-coating
HS Code	7110.1900

Caution

Platisol T/SP is a photo-sensitive product.
Avoid prolonged exposure to strong light sources. Store in dark.

Retail Quantities

5 g	ref.	41250
10 g	ref.	41211
20 g	ref.	41221
50 g	ref.	41251
100 g	ref.	41212
200 g	ref.	41222
500 g	ref.	41252
1 kg	ref.	41213

Pricing on product page:
solx.ch/platisoltsp

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, Platisol T/SP is also available in bulk for industrial purpose. Inquiries are welcome.

USAGE

Most Dye Solar Cells (DSC) are using cathodes coated with platinum. The presence of a catalytic amount of platinum at the cathode enhances greatly the electron transfer rate to the electrolyte. This is in turn increasing the charge density in the solar cell, which directly translates into higher photo-currents.

Platisol T/SP is a viscous paste containing a precursor of platinum, which is transformed into an activated platinum coating by heat treatment at 450°C. This product is specifically formulated as an ink for screen-printing. Platisol T/SP can also be processed by doctor-blading/slot-coating, a technique that is easily performed manually and that leads to evenly deposited layers.

After firing, the paste is reduced to a minimal amount of platinum for optimum material usage, while remaining ideally transparent and catalytically active.

Doctor-Blading/Slot-Coating

Make sure to clean your substrates appropriately before applying Platisol T/SP. The presence of dirt on the surface can prevent a proper deposition of platinum.

You may be familiar with the preparation of titania electrodes for Dye Solar Cells by doctor-blading, the deposition of Platisol T/SP is a very similar process.

With the conductive side facing up, apply two parallel strips of adhesive tape on the edges of the substrate, covering about 5 to 7 mm. If you are not using a vacuum chuck, take advantage of the adhesive tape to hold the substrate in position on the workbench. If you are using a slot-coating machine, it is likely the adhesive tape is superfluous.

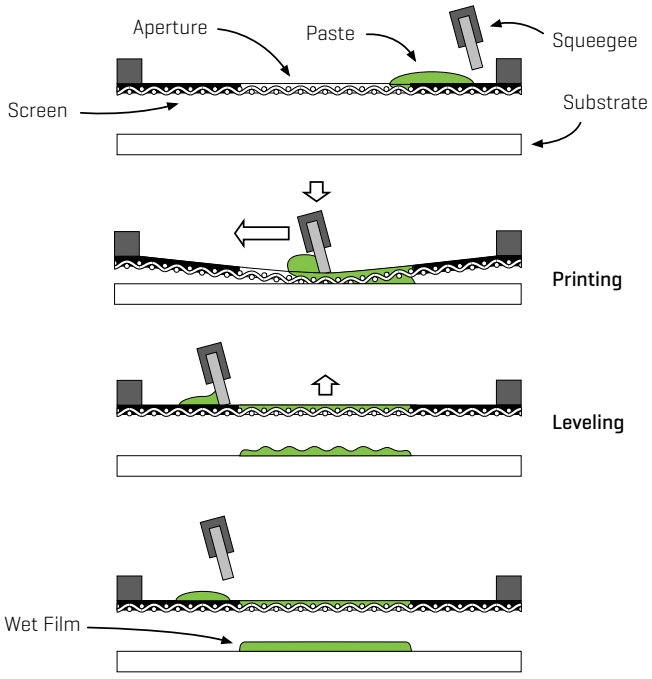
Apply a portion of platinum precursor paste near the top edge of the substrate. With a rigid squeegee, or a slot-coater, spread the paste down the substrate in a smooth a regular movement. Remove the adhesive tapes if any. The surface of the substrate should be covered by a wet layer of platinum precursor paste.

A single pass is enough to obtain a catalytic layer of platinum. It is possible to apply several passes to increase the quantity of platinum, but this may lead to a darker layer after firing.

Screen-Printing Alternative

Screen-printing is an ubiquitous printing technique for which exists a variety of equipment, from hand operated setups to fully automated high-end machines. Teaching screen-printing is beyond the scope of this document, below is the basic principle of the technique.

Put a portion of Platisol T/SP, enough accomplish at least one complete print, at the top of the screen outside the stencil motif. Wet the squeegee with the paste, and spread it smoothly across the screen, while applying enough pressure to press the screen onto the underlying substrate.



Schematic representation of the screen-printing process

The squeegee forces the paste through the apertures in the screen mesh, leaving a wet layer of ink onto the substrate at the desired place. The mesh size determines the amount of ink left on the substrate.

We recommend using Platisol T/SP with a 68 thread/cm, 55 µm diameter polyester mesh.

It is possible to stack several prints of Platisol T/SP in order to tune the amount platinum on the substrate. Typically 1-3 prints are used.

Firing

The wet the layer must be fired prior use of the electrodes, in order to remove the organic vehicle, and form the activated platinum coating.

It is also possible to dry the freshly printed layer for storage of the electrodes in the dark. Simply place the printed substrates onto a 100°C hotplate for about 5 minutes. Otherwise, directly fire the wet substrates using the following procedure.

Place the wet (or dried) substrates on a programmable hot plate and warm them up to 450°C with a gentle thermal ramp. Maintain 450°C for at least 10 minutes before allowing the samples to cool down to room temperature. Beware that an abrupt rise or drop in temperature can easily shatter glass substates.

Don't expose excessively wet samples to light. This could degrade the platinum precursor in the paint before it forms the platinum layer.

The resulting electrodes will now bear a quasi-invisible layer of activated platinum. The amount of material is enough for an excellent catalysis of electron transfer in Dye Solar Cells without using an excess of platinum.

The catalytic activity of the platinum layer can be easily tested with hydrogen peroxide once your samples have reached room temperature. Place a drop of a solution of hydrogen peroxide (aqueous, 35%) anywhere on the treated surface, but preferably outside the active areas of the solar cell. The evolution of tiny bubbles of oxygen should be visible immediately within the liquid, indicating the presence of an activated layer of platinum.

Clean with deionized water and ethanol to remove any trace of hydrogen peroxide prior use of the platinum electrode.

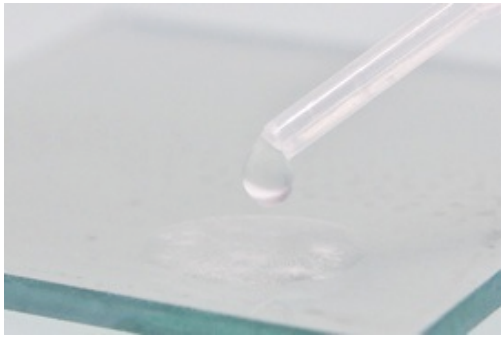
Make sure to assemble the solar cells rapidly. Such platinum coated electrodes can slowly lose their activity over time when exposed to ambient air. Keep them in a sealed environment until you are ready for assembly.

Platinum coated electrodes prepared long ago before assembly can be reactivated with a new firing treatment as described above. When in doubt, test with H_2O_2.

Common Pitfalls

Prolonged exposure to bright light of the wet samples or stock Platisol T/SP may degrade the product. Incomplete coverage of the electrode may result in no, or very little, bubbling with the H_2O_2 test. Both of these cases will result in lower cell performance than expected, but can be easily repaired by applying a fresh coating of Platisol T/SP.

Storing prepared platinum electrodes for too long will cause the platinum layer to be deactivated over time. In a cell the catalysis will be too weak resulting in low performance. In this case it is possible to reactivate these electrodes with a subsequent firing process as described above.



Evolution of O_2 in aqueous H_2O_2 showing the presence of activated platinum

EXAMPLE

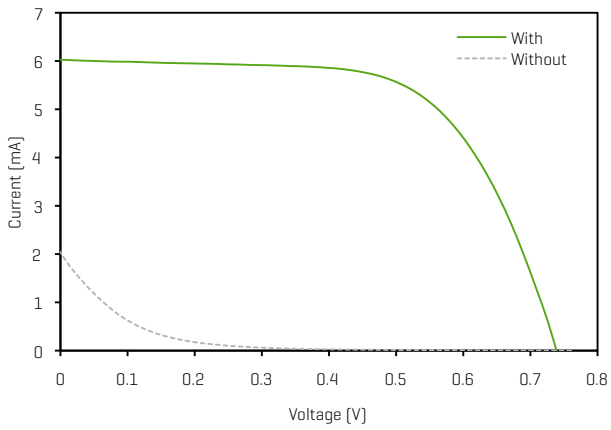
Effect of Platisol T/SP treatment in Dye Solar Cells

Two sets of Dye Solar Cells were fabricated, without and with Platisol T/SP treatment of the cathodes. For all these cells, a 36 mm^2 titania photo-anode was prepared with 4 printed layers of Ti-Nanoxide T/SP and 1 printed layer of Ti-Nanoxide R/SP on a TCO22-7 glass substrate, and sensitized with Ruthenizer 535-bisTBA in the presence of Chenodeoxycholic Acid.

All cathodes were made of TCO22-7, the first set were used without platinum coating, while the second set were treated with Platisol T/SP using the procedure described in this document.

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 cells were placed under 1 sun illumination using a Solaronix Solixon Class-A solar simulator, and equipped with an adequate mask to avoid overestimated results.



	Without		With
V_{oc}	726 mV	V_{oc}	739 mV
J_{sc}	5.6 mA/cm^2	J_{sc}	16.74 mA/cm^2
FF	0.04	FF	0.64
Eff.	0.2 %	Eff.	7.9 %

STORAGE AND SAFETY

Storage

Caution, Platisol T/SP is a photo-sensitive product. Store the product in the dark in its original opaque container, upright and tightly sealed. Keep in a dry place at room temperature.

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

While in use, avoid to keep the container open unnecessarily, and avoid prolongated exposure to light.

Safety

Platisol T/SP is for research and development use only, and is intended to be manipulated by knowledgeable 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 Platisol T/SP.

solaronix.com/msds/

RELATED PRODUCTS

Cited in This Document

- Ruthenizer 535-bisTBA, industry standard photo-sensitizer.
- Chenodeoxycholic Acid, staining additive.
- TCO22–7, 7 ohm/sq. FTO coated glass substrates.
- Ti–Nanoxide T/SP, screen-printable titania nanoparticle paste.
- Ti–Nanoxide R/SP, screen-printable reflective titania paste.
- Iodolyte HI–30, very high performance electrolyte.
- Meltonix 1170-60, hot-melt sealing films.
- Solixon, continuous illumination solar simulators.

Consider Also

- Platisol T, platinum precursor paint.
- TCO22-15, 15 ohm/sq. FTO coated glass substrates.
- TCO30-8, 8 ohm/sq. FTO coated glass substrates.
- Labware: Plastic Spatulas.

REFERENCES

People Using Platisol T

A selection of publications using Platisol T:

- Journal of Power Source, 2013, 239, 122-127 [doi:10.1016/j.powsour.2013.03.079]
- Solar Energy Materials & Solar Cells 2013, 117, 9-14 [doi:10.1016/j.solmat.2013.05.012]

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