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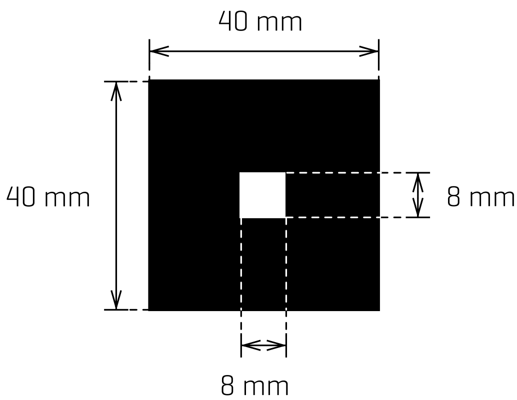
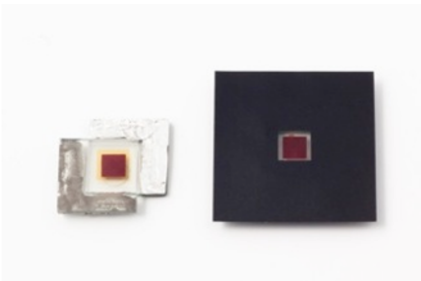
Test Cell Mask

Adhesive Opaque Aperture for Test Cells



A must have for the accurate performance assessment of Dye Solar Cells. The Test Cell Mask is an opaque sticker with a tailored aperture that hides the non-active area of the cell while compensating for the optical loses inherent to masking. A low tack adhesive makes the mask easily reusable. The Test Cell Mask allow for unbiased measurements of our Test Cells and others cells made with our Test Cell Kits.



Characteristics

Dimensions	40 x 40 mm
Aperture	8 x 8 mm
Compatibility	Test Cells, Test Cell Kits (solar cells with an active area of 6 x 6 mm)
HS Code	3919.9000

Reference

ref. 74601 (16 pcs.)

Pricing of the Test Cell Masks and the other Test Cell spare parts on the product page:
solx.ch/testcellparts

Best Used With

Our Test Cells and other cells made with our Test Cell Kits:

ref. 74991 (parts only)

ref. 74992 (parts and chemicals)

For more details about the Test Cell Kits go to:
solx.ch/testcellkit

How to Order

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

USAGE

Depending on the electrical connections offered by your measurement setup, you may find it easiest to attach the connectors prior to positioning the mask.

Remove the mask from its liner, and carefully center it over the active area of the solar cell being measured. The sticker can be removed and repositioned if necessary. Make sure to remove any air bubbles which may have formed.

> *The alignment of the aperture with the active area, though preferably centered, is not extremely critical to the accuracy of the measurements as explained below.*

You can now illuminate and measure your sample. Take advantage of the oversized mask and fold it around the sides of your cell to prevent light from entering through the edges.

For the calculation of the solar cell efficiency, simply use the active area, 0.36 cm^2.

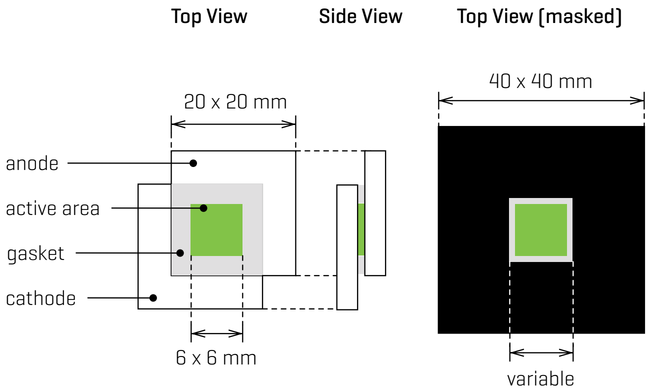
EXPLANATIONS

As described by Ito et Al. in *Photovoltaic Characterization of Dye-sensitized Solar Cells: Effect of Device Masking on Conversion Efficiency* (Prog. Photovolt: Res. Appl. 2006, 14, 589-601, doi:10.1002/pip.683), the masking of Dye Solar Cells for measuring their efficiency is critical. The absence of masking, or an inappropriate aperture size, can induce a massive bias in the recorded values.

Correlation Between Mask Aperture and Efficiency

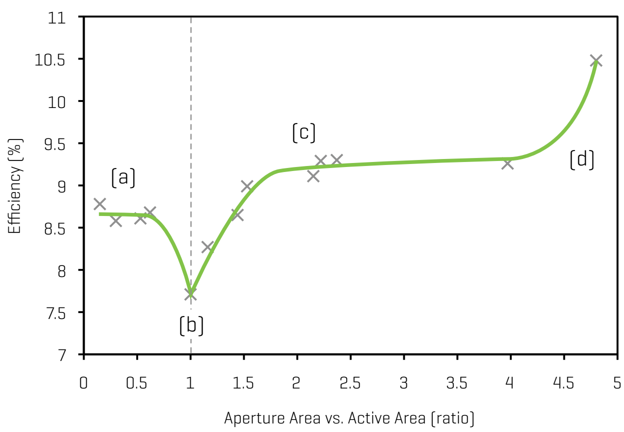
To illustrate the importance of using a tailored mask, we have conducted similar experiments with our Test Cells and measured them with masks of different apertures.

The Test Cells were fabricated as follow. A 36 mm^2 titania photo-anode was prepared with 3 prints of Ti−Nanoxide T/SP and 1 print of Ti−Nanoxide R/SP on a piece of TCO22−7 glass substrate. The electrode was treated with $TiCl_4$, and 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 2 prints of Platisol T/SP. The two electrodes were laminated together using Meltonix 1170-60, and the solar cell was filled with Iodolyte AN-50 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.



Schematic representation of a Test Cell

The resulting solar cells were placed under 1 sun illumination using a Solaronix Solixon Class-A solar simulator and equipped without or with masks of different apertures. The conversion efficiencies obtained are plotted below for the different dimensions.



Efficiency of the solar cell versus the ratio between mask aperture and active area.

Ratio = 1 when the aperture equals the active area.
For ratios inferior to 1, the efficiencies were corrected with the aperture area instead of the active area.

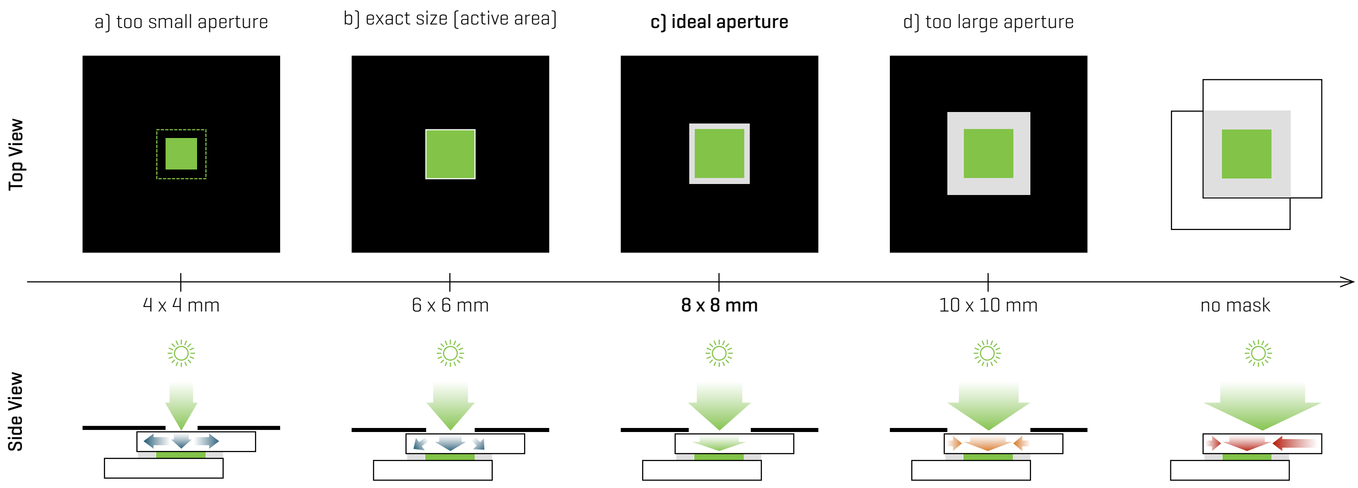


Illustration of the different mask apertures and their effects on active area illumination.

Case (a) The aperture is smaller than the active area:

A first approach consists in a mask aperture that's purposely smaller than the active area, and a calculation of the efficiency derived from the aperture area. Several phenomena are in competition, the fill-factor ramps up thanks to reduced ohmic losses at lower current density, but the V_{oc} declines due to an increased contribution of dark current under low illumination. Although the performance is higher when compared to the absolute minimum observed in case (b), it is underestimated.

Case (b) The aperture matches the size of the active area:

The next evident solution is an aperture size which equals the active area. Surprisingly enough, this is in practice the most detrimental setup. Not only is it hard to precisely align the mask correctly, but the mask edges always cast a shadow that significantly reduces the contribution of diffuse light to the illumination of the sample. The current density is therefore relatively low, and the efficiency is underestimated since there isn't any positive contribution as shown in case (a). The depth of the plot at this point mostly depends on the thickness of the front glass, or in other words, the distance between the mask and the active area.

Case (c) The aperture is slightly larger than the active area:

When the aperture is slightly larger than the active area, the efficiency increases to a plateau where the detrimental phenomena observed in case (a) and (b) are no longer impeding the measurement. The wider aperture compensates for the optical losses at the mask edges. The sample is now correctly lit, and receives both direct and indirect light. Interestingly, the solar cell efficiency is not very sensitive to the aperture size within a certain range. This lets us measure very accurate results, even when the mask is not perfectly centered.

The Test Cell Mask matches these optimum conditions for our Test Cells and allows for an accurate performance assess.

Case (d) The aperture is much larger than the active area, or the mask is absent:

Apertures larger than the optimum size allow extra light to be collected by the front glass. This increases the illumination actually received by the active area and the results become overestimated. This phenomenon is is clearly observed in the absence of mask. The bias grows with the glass thickness and the dimensions of the front electrode.

Summary of Mask Aperture Dependency

The mask aperture dependency highlighted by the above experiments is summarized in the table below:

Aperture	Mask is...	Efficiency	Result is...
4 x 4 mm	too small	8.6 %*	underestimated
6 x 6 mm	exact size	7.7 %	vastly underestimated
8 x 8mm	**ideal**	**9.0 %**	**accurate**
10 x 10 mm	too large	9.3 %	overestimated
infinite	without mask	10.5 %	vastly overestimated

(*) corrected with the aperture area instead of the active area.

RELATED PRODUCTS

Test Cell Kits

- Test Cell Kit, parts only (ref. 74991)
- Test Cell Kit, parts and chemicals (ref. 74992)

Test Cell Spare Parts

- Titania Electrodes, opaque, 16 pcs. (ref. 74101)
- Platinum Electrodes, drilled, 16 pcs. (ref. 74201)
- Bare Electrodes, drilled, 16 pcs. (ref. 74701)
- Gaskets, 20 pcs. (ref. 74301)
- Sealings, 20 pcs. (ref. 74401)
- Caps, 20 pcs. (ref. 74501)
- Masks, 16pcs. (ref. 74601)

REFERENCES

Photovoltaic Characterization of Dye-sensitized Solar Cells: Effect of Device Masking on Conversion Efficiency
Prog. Photovolt. Res. Appl. 2006, 14, 589–601
[doi:10.1002/pip.683]

Find Out More

Visit the Test Cell Spare Parts product page for more information: solx.ch/testcellparts

How to Order

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

Feedback

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