Technical Assistance Request | ETC Solar LLC

Invisible metal contacts for solar cells

Background information:

Metal contacts and transparent conductive oxides (TCOs) are used for charge extraction from solar cells. Conventional metal contact grids typically cover ~5% of the solar cell front surface, blocking sunlight from reaching the photovoltaic material below. Front contacts contribute 4-5% to electrical current losses. This is the largest single contribution to performance loss in solar cells. Great effort has been devoted to overcoming metal grid shading losses by using TCOs. However, TCOs provide low loss lateral charge transport only over small areas and short distances, and also, exhibit parasitic absorption, which leads to loss in electrical current density of 3-5%.

ETC Solar, LLC is commercializing world's highest performing front contact technology for solar cells: effectively transparent contact (ETC) superstrates. ETC superstrates are the first industrially viable approach to completely eliminate front-grid shading loss of flat metal contacts and significantly reduce parasitic absorption in transparent conductive oxide (TCO) layers.

Effectively transparent contacts (ETCs) are triangular shaped, micro-scale, high aspect ratio metal contacts that efficiently redirect incoming sunlight and thereby exhibit 99.9% optical transparency while providing excellent conductivity. In order to integrate ETCs with solar cells, ETC Solar fabricates thin polymer sheets embedded with ETCs.

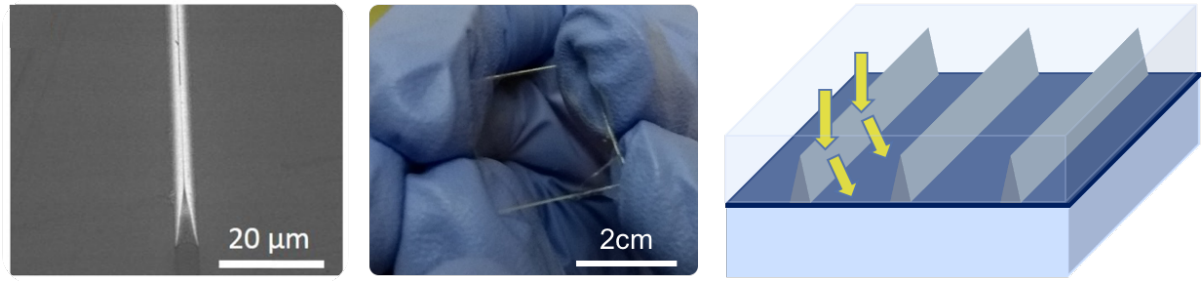
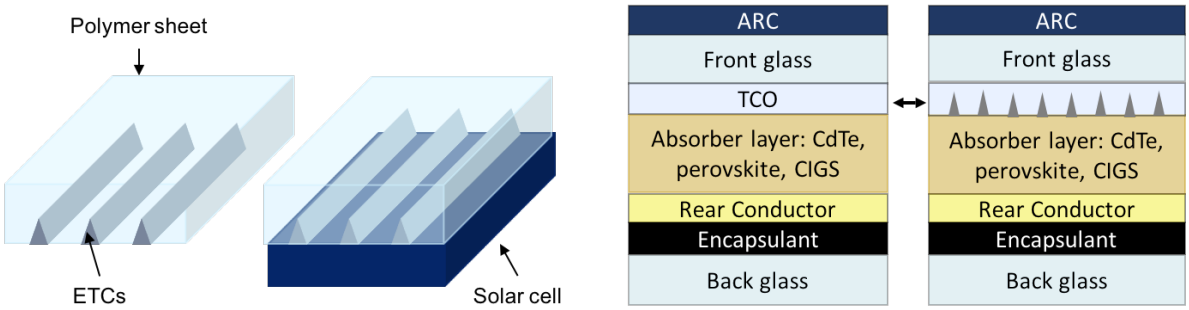


Figure 1: a) Scanning electron microscope (SEM) image of a single ETC, b) 2x2 cm ETC superstrate with 99.9% optical transparency and high conductivity (<5Ω/sq) and c) Schematic of ETC superstrate integrated on top of a solar cell providing power output boost by redirecting the incoming sunlight.

The ETC technology achieves dramatically finer metal contact features (5 µm width and 15 µm height, see Fig. 1a) than industry standard technologies, which have well-known limitations of linewidth and aspect ratios. The ETC superstrate (Fig. 1b) exhibits 99.9% optical transparency and achieves high conductivity (<5Ω/sq) by embedding ETCs in a thin polymer sheet. ETC Solar has demonstrated that by integrating ETCs with solar cells the power output can boosted by 5% by mitigating shading losses and reducing parasitic absorption in TCO layers.

The ETC superstrates are a superior solution to flat metal contacts and TCOs and are compatible with III-V, thin-film and silicon solar cells (see fig. 3) – which makes ETC technology a powerful generic solution to address front-contact optical losses. For thin-film solar cell manufacturers the ETC superstrates are a drop-in replacement of the conventional TCO layer used in any thin-film solar module.



a) Integration with III-V or silicon solar cells **b) Integration with thin-film solar cells**

Figure 3: a) ETC superstrates are integrated with III-V or silicon solar cells to mitigate shading losses causes by flat metal contacts and improve sheet resistance with high aspect ratio ETCs and b) ETC superstrates are a drop-in replacement of the conventional TCO layer in thin-film solar cells, reduce parasitic absorption drastically.

Goals:

1) Integrate ETC Superstrates with 1x1 cm III-V solar cells to mitigate shading losses and improve the electrical conductivity.

2) Integrate ETC Superstrates with full-sized commercial III-V solar cells to mitigate shading losses and boost the solar cell power output.

3) Fabricate a full-sized commercial III-V module with integrated ETC Superstrates and thereby set a new world-record production module efficiency for III-V solar modules.

4) Conduct reliability and durability testing of the ETC Superstrates on top of III-V solar cells, i) adhesion testing and ii) accelerated lifetime testing.

5) Obtain 3rd party validation of the performance boost due to integrated ETC Superstrates on top of the III-V solar cells (STC testing).

6) Conduct field-testing of the III-V module with integrated ETC Superstrates.

Assistance request:

To achieve the above-mentioned milestones, ETC Solar is seeking technical assistance to increase the changes of successfully integrating ETC Superstrates with III-V solar modules.

ETC Solar would like to hire two consultants through the American-Made Network to assist and advice on the integration of ETC Superstrates with III-V solar cells, 1) polymer expert and 2) silver ink/paste expert.

ETC Solar would like to conduct durability and reliability testing of the ETC Superstrate integrated with III-V solar modules at the national laboratories through the voucher.

ETC Solar would like to conduct field-testing of the ETC Superstrate integrated with III-V solar modules at the national laboratories through the voucher

In order to obtain 3rd party validation of the performance increase by mitigating shading losses, ETC Solar would like to conduct performance testing under standard test conditions (STC) at the national laboratories through the voucher.