Silver Paste Metallization for Perovskite Solar Cells

Solar Prize Round 6 Competition

Project Summary

Perovskite solar cells (PSC) have shown remarkable progress with rapid increases in power conversion efficiency to 26% for single-junction devices and 31% for tandem perovskite/HJT silicon solar cells. Currently, vacuum deposition of silver electrodes for making PSC devices is not only time-consuming and costly, but also requires a patterning process to produce grid electrodes for reducing light shadowing. We propose printed silver electrodes to replace vacuum deposited silver in this program. Metallization process for PSCs requires low temperature processes below 140 °C and there are no state-of-the-art silver pastes that have good electrical properties to meet the technical specifications. Our proprietary organic binder system allows low temperature sintering of silver powders to achieve low resistivity when cured at 130°C. Successful development with this program will provide a low-cost and mass-production metallization solution for manufacturing PSC in large scales and will accelerate commercializing perovskite solar technology.

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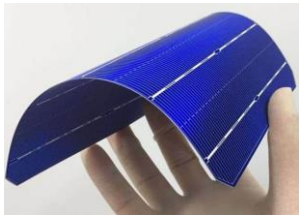
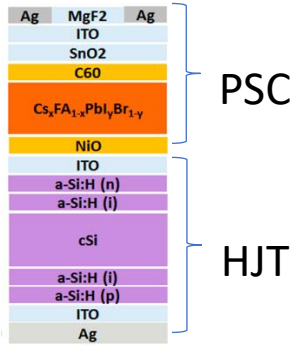
Project Objectives

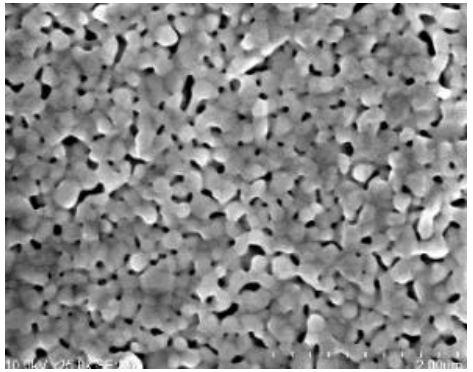
1) Silver paste can be cured at temperature below 140°C,
2) Specific contact resistivity (ρ_c): < 1m Ω.cm^2 on ITO contact layer of PSCs, cured at 130°C,
3) Bulk resistivity of silver paste: <4.5 μΩ.cm,
4) Fine line printing: < 50 μm wide grid lines,
5) Adhesion: 5B with tape test.



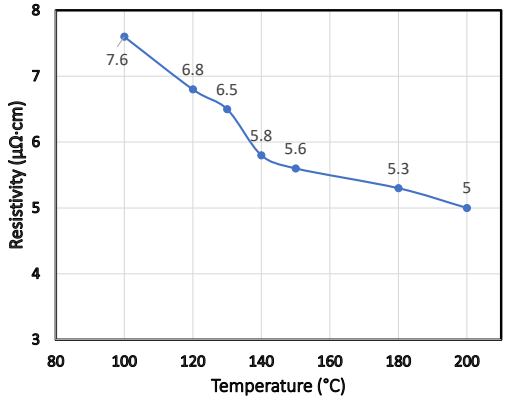
HJT silicon solar cell with printed silver grid electrodes



Ag grid electrodes can be printed on Perovskite/HJT tandem solar cell



Silver powders with unique particle shape and size distribution are sintered at 120 °C



Low resistivity at low curing temperatures

Table I. Electrical properties of silver pastes printed on ITO and cured at 130°C.

Silver Paste	Binder system	Silver powders	Specific contact resistivity (mΩ.cm^2)	Bulk resistivity (μΩ.cm)
Paste 1	A	Ag-1	0.4	120
Paste 2	B	Ag-2	0.6	25
Paste 3	C	Ag-2	6	7
paste 4	D	Ag-2	20	6
Refrene paste	N/A	N/A	60	8
Target paste			**<1**	**<5**

Impact

- Low temperature silver paste metallization solution will provide a low-cost mass production for perovskite solar cell manufacturing. Printed silver fine-line grid electrodes for PSCs make bi-facial perovskite solar modules possible.
- Low-temperature curing silver pastes made in US will enhance the U.S. domestic solar supply chain and help build solar panels in US.