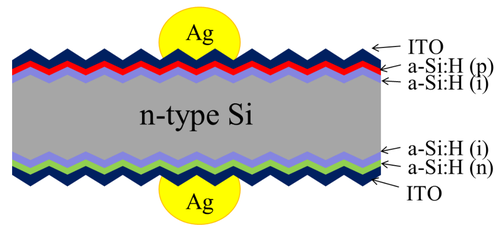
Low temperature pastes for perovskite/heterojunction tandem solar cell applications

Background

- Metallization cost of heterojunction and tandem solar cells are the most expensive.
- SHJ and perovskite tandem solar cells are heavily depending on Silver (Ag) metalization.
- At 1 TW level, PV will consume more than 80% of the current Ag resources in 2030
- Sustainability and Eco-system, circular economy and role of industry .
- In this work, We investigate the possibility to use low cost Ag-coated aluminum fillers to replace silver.

Low Temperature Pastes

- THA-F22D Ag Core
- THA-FB22 Ag Core (Solderable)

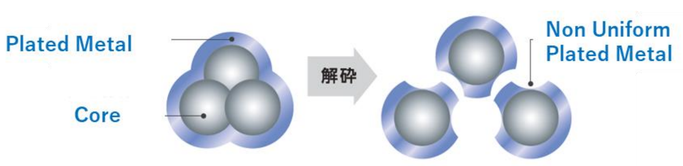


- THA-F22C Ag-Coated Cu Core
- THA-B22C Ag-Coated Cu Core (Solderable)
- THA-F22A Ag-Coated Al Core
- THA-F22S Ag-Coated SiO2 Core

Technology

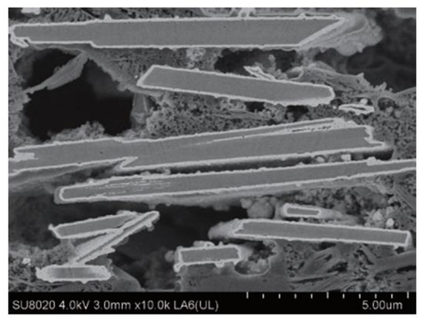
Ag-Coated Aluminum Fabrication Process

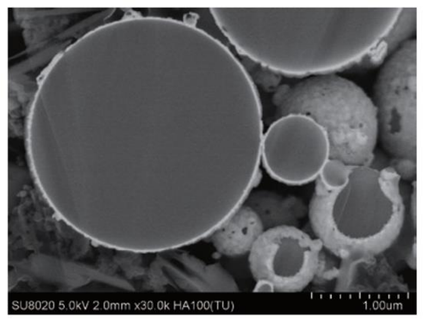
Plating while dispersed to avoid agglomeration, core particles are plated individually and covered completely for the best effect.

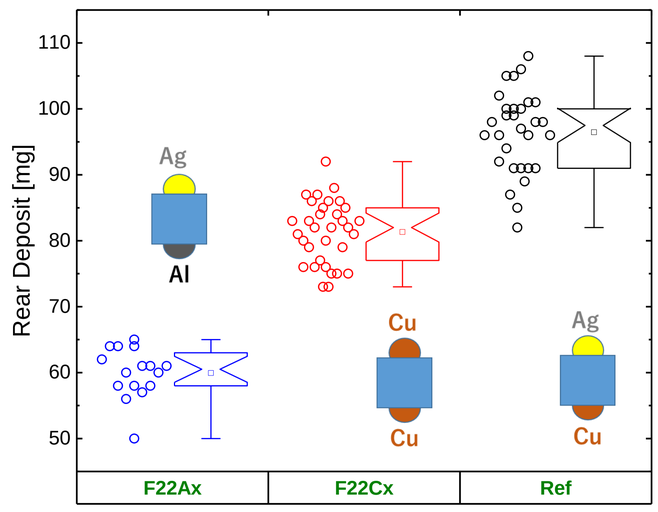


Toyo

Nano-size dispersed plating also possible in order to enhanced characteristics of both the plated metal and core particle. Double-layer functional plating with different metals, such as, for example, creating the outer contact layer and the middle layer as buffer/barrier over the core particle.







The Ag-coated Al and Cu particles helped in reducing the amount of metallization laydown due to the volume/weight balance

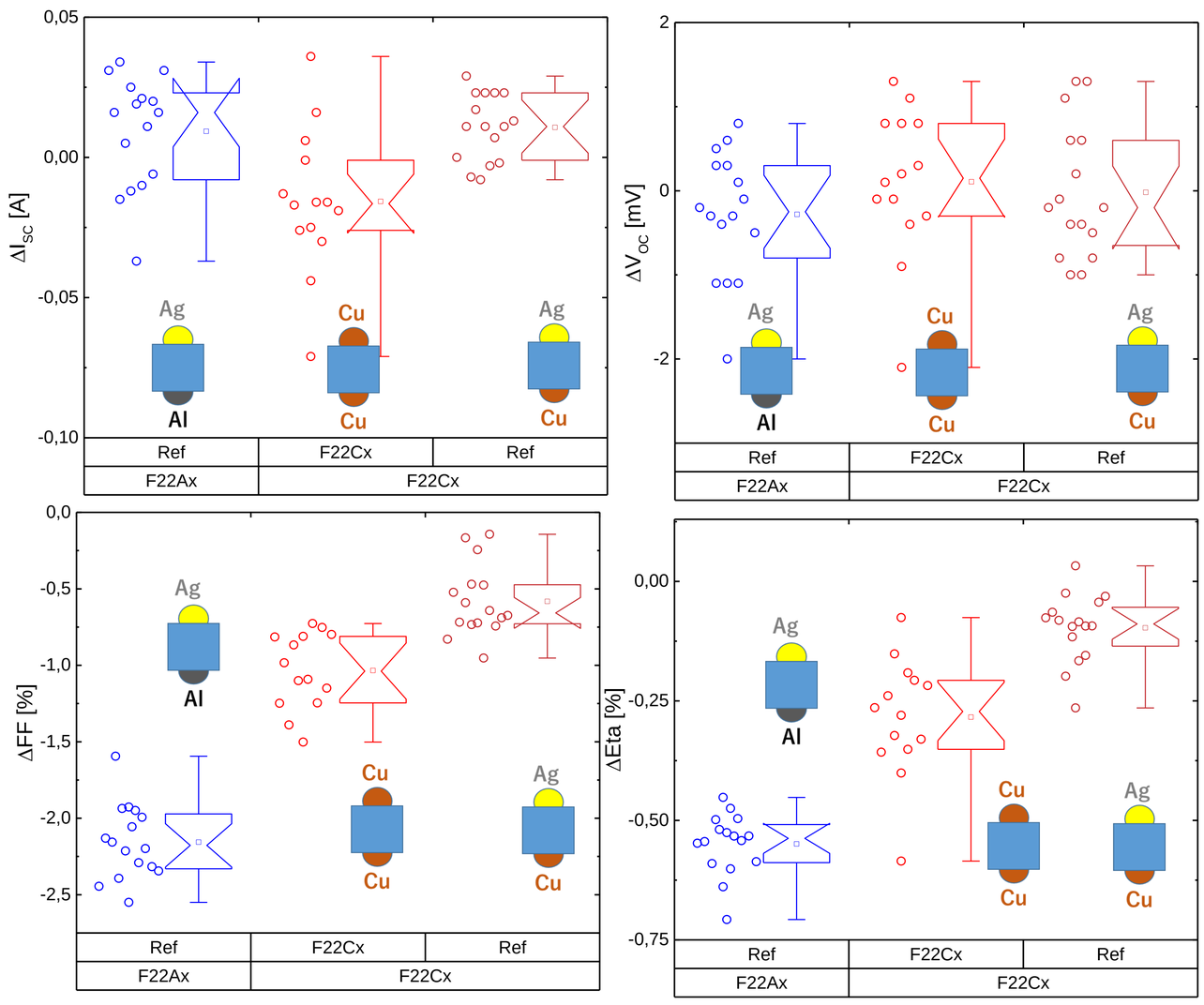
Experiment Results and Discussion

Paste Making and Electrical Properties

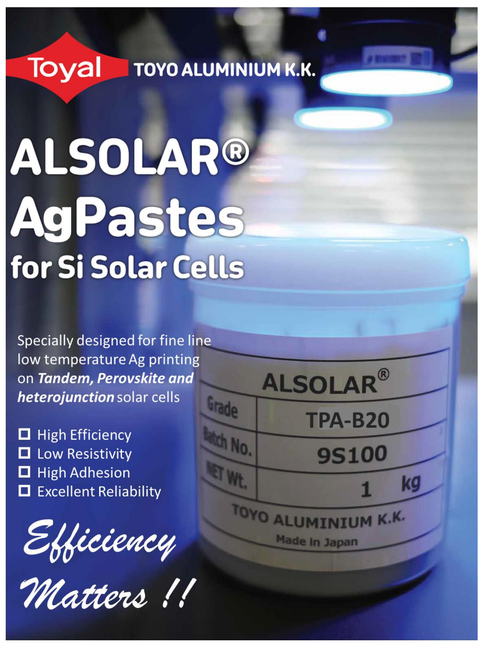
- Ag-coated Aluminum (Al) and copper (Cu) particles were chosen carefully to meet the standard requirement of the printing process of conventional low temperature pastes. Ag powders with different sizes and shapes were mixed with Ag-coated Al particles in special ratio to adjust volume/weight optimized for printing.

- The pastes were then printed on conventional heterojunction solar cells with initial printing pattern with different finger opening, 30, 35, 40, 45 and 50mm to investigate the electrical properties of the final fingers.

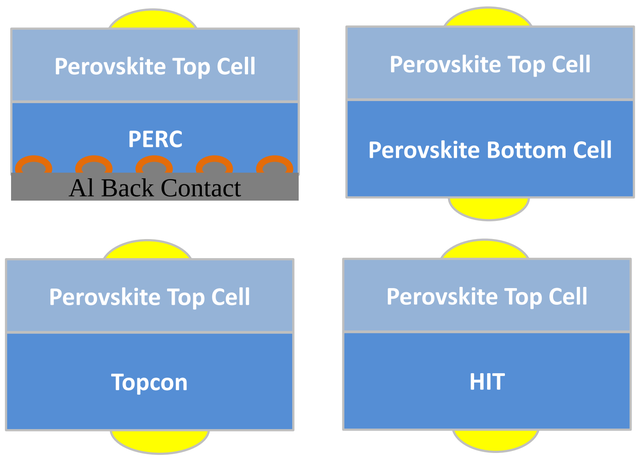
- Solar cells were made with the Ag-coated Al and Cu pastes at LITEN CEA, INES in a collaborative joint research work.
- The solar cells metalized with front Cu paste suffered a small reduction in short circuit current I_{sc} due to wider fingers
- The open circuit voltage were the same to the base line of Ag/Ag solar cells and no significant differences were observed.
- The fill factor of all cell gropes was below the Ag/Ag reference due to the decrease of paste conductivity witch is as consequence of using Al and Cu in the paste
- - 10% paste consumption for Ag-coated Cu paste and 33% paste consumption for Ag-coated Al paste.



Tandem Perovskite



Curing Temp. 120-150°C



TPA-B20 (Solderable, BB only)
TPA-FB22 (Solderable, BBs + Fingers)
TPA-F22 R&D Fingers