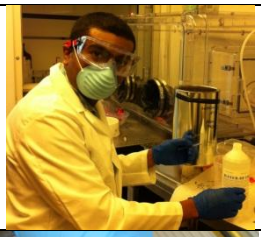
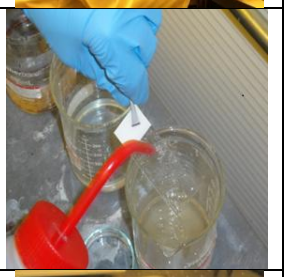
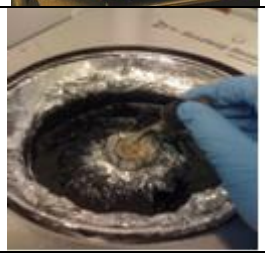
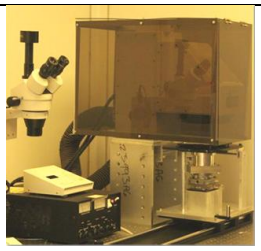
SOLAR CELL FABRICATION PROCEDURE
KASSEGNE'S MEMS LAB
CLASS 100 CLEANROOM

Negative Photolithography Procedure

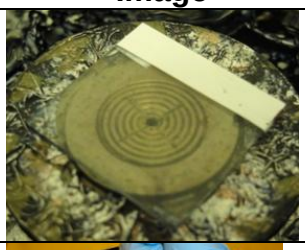
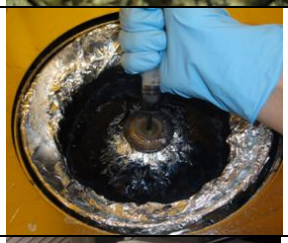
Procedure	Details	Specifications	Image
Cutting of the Substrate	PET , Silicon, Glass	1.5 cm X 1.5 cm	
Cleaning of the Substrate (Step 1)	Ultrasonic Bath in diluted detergent; Rinse with DI-H2O	10 mins	
Cleaning of the Substrate (Step 2)	Wash with HF	5 ml	
Cleaning of the Substrate (Step 3)	IPA-Acetone-IPA Blow dry with N_2 gun	2 times	
Dehydration Bake	Hotplate	45 mins ; 50°C	
Negative Photoresist Spin Coating Rate Spin Coating Time	SU-8 (10/100) 2000 to 3000 RPM 45s	3 ml Gradually ramp up	

Soft Bake Temperature Soft Bake Time Gradual Ramp Down	65 - 100°C 15 - 50 mins Cool down to room temperature	Gradual ramp up Divide in equal intervals of 5°C Gradually on the hot-plate itself	
UV Exposure Intensity UV Exposure Time	6 - 8.5 mW/cm2 20s to 40s	Optimum suction	
Post Exposure Bake Temperature Post Exposure Bake Time Gradual Ramp Down	65 - 110°C 25 - 75 mins Cool down to room temperature	Gradually ramp up Divide in equal intervals of 5°C Gradually on the hotplate itself	
Developer Developing Method Developing Time	SU8 Developer Manually 10 sec to 30 sec	100% Concentration Under fume hood	
IPA Rinse Blow Air Dry	Wash with IPA Low intensity	Undeveloped SU8 will create a white film; if so develop again Until chip gets dry	

Material Deposition

Layers of materials are then deposited on the micro-pillars developed. The procedure begins with the deposition of Orgacon™, followed by P3HT:PCBM deposition, and finally a layer of Aluminum deposition. The entire procedure is tabulated below:

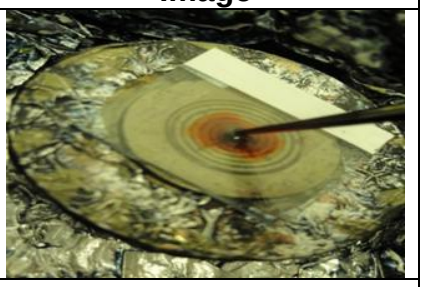
A. Orgacon™ Deposition

Procedure	Details	Specifications	Image
Teflon Tape	On one side		
1st Layer Coating	Spin Coat	550 RPM; 45s	
1st Layer Baking	Hotplate	120°C ; 3 mins	
Check conductivity	Multi-meter	Should be 0.2 – 1kΩ; if not go to next step (chip should be transparent after each layer)	
2nd Layer Coating	Spin Coat	350 RPM; 45 sec	
2nd Layer Baking	Hotplate	120 degree-C ; 3 mins	
Check conductivity	Multi-meter	Should be 0.2 – 1kΩ; if not go to next step	
3rd Layer Coating	Spin Coat	350 RPM; 45 sec	
3rd Layer Baking	Hotplate	120 degree-C ; 3 mins	
Check conductivity	Multi-meter	Should be 0.2 – 1kΩ	

B. P3HT:PCBM Deposition

Prior to deposition, 0.0255g of P3HT:PCBM and 1.5mL of dichlorobenzene are accurately weighed and prepared. The chemicals are then mixed thoroughly in a magnetic spinner at high intensity for 12 hours. The mixture is then filtered out using a syringe as shown in the following figure:

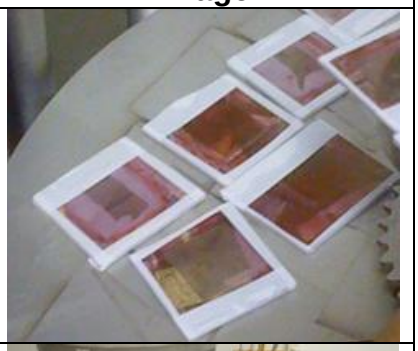
This filtered out material is then deposited as follows:

Procedure	Details	Parameters	Image
Spin Coating	350 RPM	45 sec	
Air drying	in closed dark container	2 hours	
Annealing	in N2 environment oven	12 hours	

C. Aluminum Deposition

Aluminum deposition is performed in a thermal evaporator by maintaining vacuum in the bell-jar to ensure even deposition of the material layer on the chip. A vacuum below 20 m Torr is required for complete evaporation of aluminum, which is kept in a tungsten bucket inside the bell-jar.

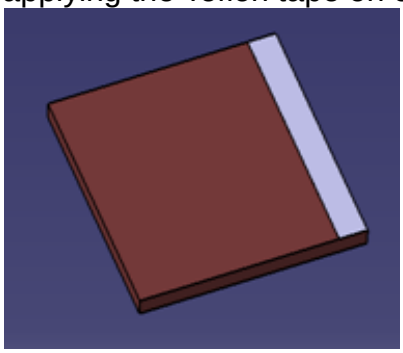
The steps in aluminum deposition are described in the following table:

Procedure	Details	Specifications	Image
Teflon Taping	All sides and partition		
Thermal Evaporation	25-30 sec	Below 40 amperes	
Place in vacuum chamber	10 mins	To settle down the **Al** particles	

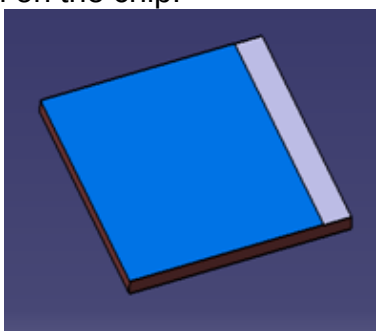
Teflon Taping

The main objective of the Teflon taping is to avoid contact between Orgacon and Aluminum in order to obtain a working solar cell and prevent any short circuit that may occur.

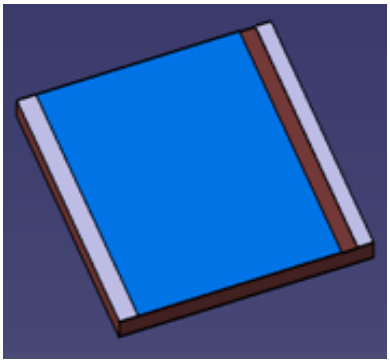
1. In this process we start by applying the Teflon tape on one side.



2. Then we deposited orgacon on the chip.

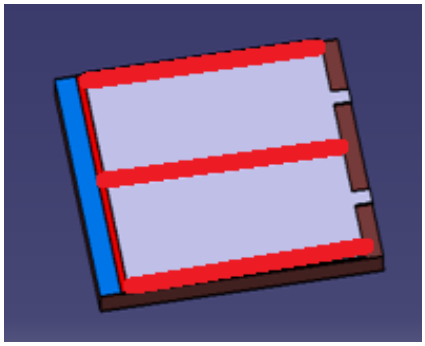


3. After this, we apply Teflon tape on the other side of the solar cell and in addition, we apply another layer of Teflon tape on the previously applied side, covering just half of the width of this side.



4. Then we deposit a layer of P3HT:PCBM and spin coat it at 350RPM for 45 seconds.

5. Two cuts are made on the blank side of the Teflon taping, and a thin strip of Teflon tape is added at the center of the solar cell in order to provide two partitions to the Aluminum layer.



6. At the end of Aluminum deposition, all Teflon tapes are removed, and the cell is tested using crocodile clips attached to the orgacon electrode (Anode) and Aluminum electrode (Cathode).

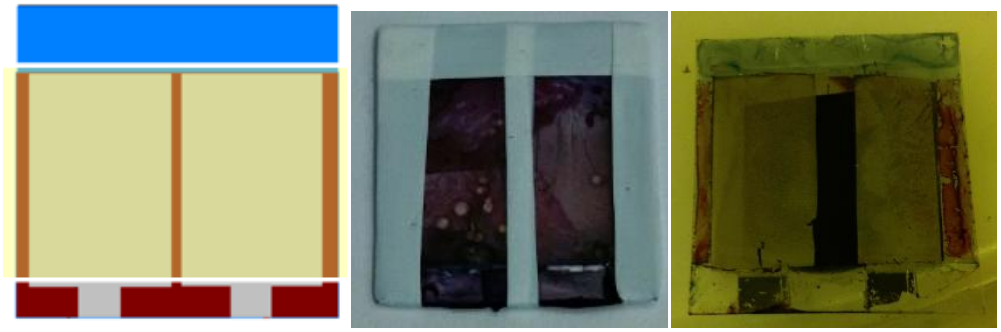


Figure: Final product

The second image above is a view of the chip with teflon taping on the three edges of the chip and at the center. Cuts made at the fourth edge allow electrical access to the aluminum which functions as the cathode. The third image is a view of the solar cell after testing and characterization of the 3D organic solar cell, which requires removal of Teflon tapes from all three edges.

This architecture does not require wire bonding since the use of crocodile clips for the electrical connection between the solar cell and the testing device is quick and saves time and also improves the packaging process.

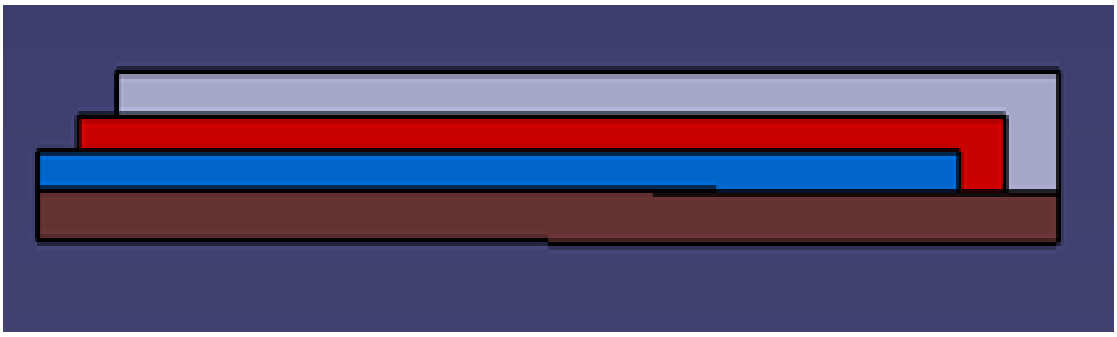


Figure: Cross-sectional view of novel architecture

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