

“WP1- Optimisation of existing material and monolithic and discrete MJ cells”.



APOLLON KICK-OFF WORKSHOP
Nicosia, 17 October 2008

F.Roca
TER-ENE-FOTO

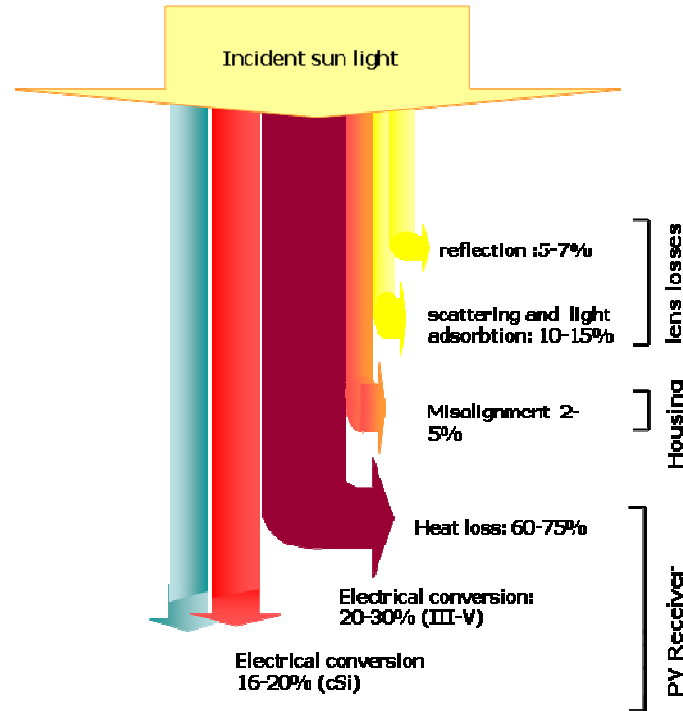
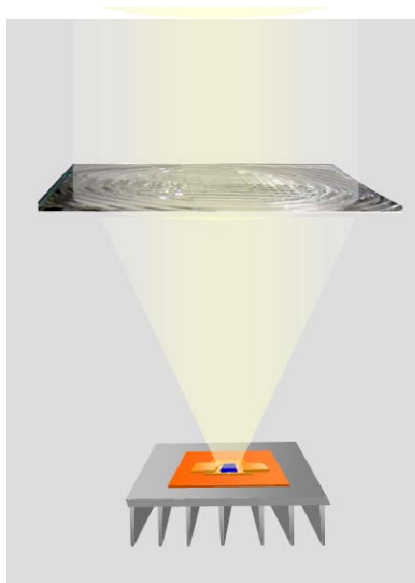


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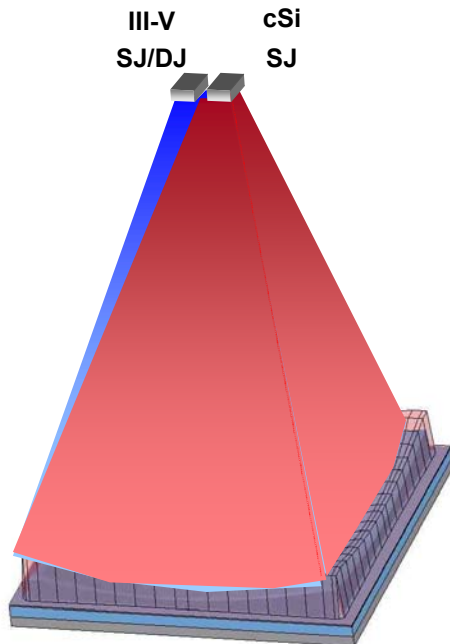


1. cSi SJ and III-V SJ/DJ Application

Point Focus Concentration



2. cSi SJ and III-V SJ/DJ Application



Two Faceted Shells stacked each on the other are designed to generate two spatially separated chromatic illuminated areas

Mirror base spectrum splitting systems (Dichroic flat faceted concentrator)

Single(SJ) or **Double (DJ)** junction cells made of material of high (~ 2 eV) energy gap (**InGaP**) are required to exploit the shorter wavelength.

cSi cells (SJ) used for longer wavelength. The current drained out from the cells is fairly lower than at the same concentration “full spectrum”:
→ more relaxed technological issues or higher limits for concentrations



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SJ & DJ PV-C Solar Cell: State of Art

➤ two site contacted PV-C cSi Solar cells and III-V SJ/DJ

- Not optimized for medium concentration. Further room available to increase efficiency at low cost
- Contact structure not actually based on automated connection in higher throughput assembling line
- Package based on the use of expensive ceramics substrates electrically insulated and having very high thermal conductivity (Al_2O_3 , AlN, etc)





WP1- Optimisation of existing material and monolithic and discrete MJ Solar Cells

Partners

- 1. ENEA (part.#8) WPL**
 - a. Modelling of Si cells for MBS system
 - b. Optimization of crystalline silicon solar cells for medium concentration
 - c. Development (modelling, growth and characterisation) of ARC coatings and protective treatment for long term stability;
 - d. Testing on ARC, UV and humidity ageing effect

- 2. ENE (part.#4)**
 - a. DJ industrial partner of the project
 - b. Optimisation of existing material and monolithic and discrete III-V DJ & MJ.

- 3. NAREC (part.#15)**
 - a. cSi SJ industrial partner of the project
 - b. LGBC cell for ultrasonic welding or alternative automated process





WP1- Tasks, Deliverable & Milestones

Task 1.1 Fabrication of High Energy Gap (InGaP) and DJ cells with the starting technology (ENE)

- a. Fabricate SJ and DJ InGaP/InGaAs cells on specification for MBS and PF systems and define the system performance baseline

Task 1.2: Optimisation of DJ (InGaP/InGaAs) cell (ENE)

- a. Adapt the doping of the MOCVD layers of the monolithically stacked MJ cells to ultra high current densities.
- b. Adapt the tunnel diode between the junctions also to ultra high current densities.
- c. Front Grid design will be matched with the light distribution produced by the Fresnel or Prismatic lenses to be developed. This activity will take benefit from the lens characterisation activity
- d. DJ solar cells with target efficiency up to 31.5 % at 750 sun and increased process yield

Task 1.3 :DJ (InGaP/InGaAs) Fabrication (ENE)

- a. Fabricate cells for the systems developed in the WP3.- Point Focus System (PF) and WP4.- Mirror Based Splitting System (MBSS)





WP1- Tasks, Deliverable & Milestones

Task 1.4: AR for long term stability (ENEA)

- a. Development of ARC coatings suitable to operate both class of PV receiver (cSi and III-V) at a range of wavelengths, from 300 - 1800nm and able to work in presence of water moisture exposure and high concentration

Task 1.5: Fabrication of Si cell with the starting technology (NaREC)

- a. NaREC will produce solar cells based on LGBC contact with gridded bus-bar and full aluminium BSF. Production of 18% efficiency at 100x solar cells expected.





WP1- Tasks, Deliverable & Milestones

Task 1.6: Optimisation, industrialisation and fabrication of Si cells for medium-high concentration (ENEA, NaREC)

1.6.1: Development of a concentrator cell for automated assembly (NAREC)

- a.** Development of alternative methods of interconnection of the cells based on ultrasonic welding.
- b.** A hybrid approach of laser grooved and planar contact areas will be developed for the cell structure

1.6.2 Optimisation of the industrial solar cell for use in IR-illumination (NAREC)

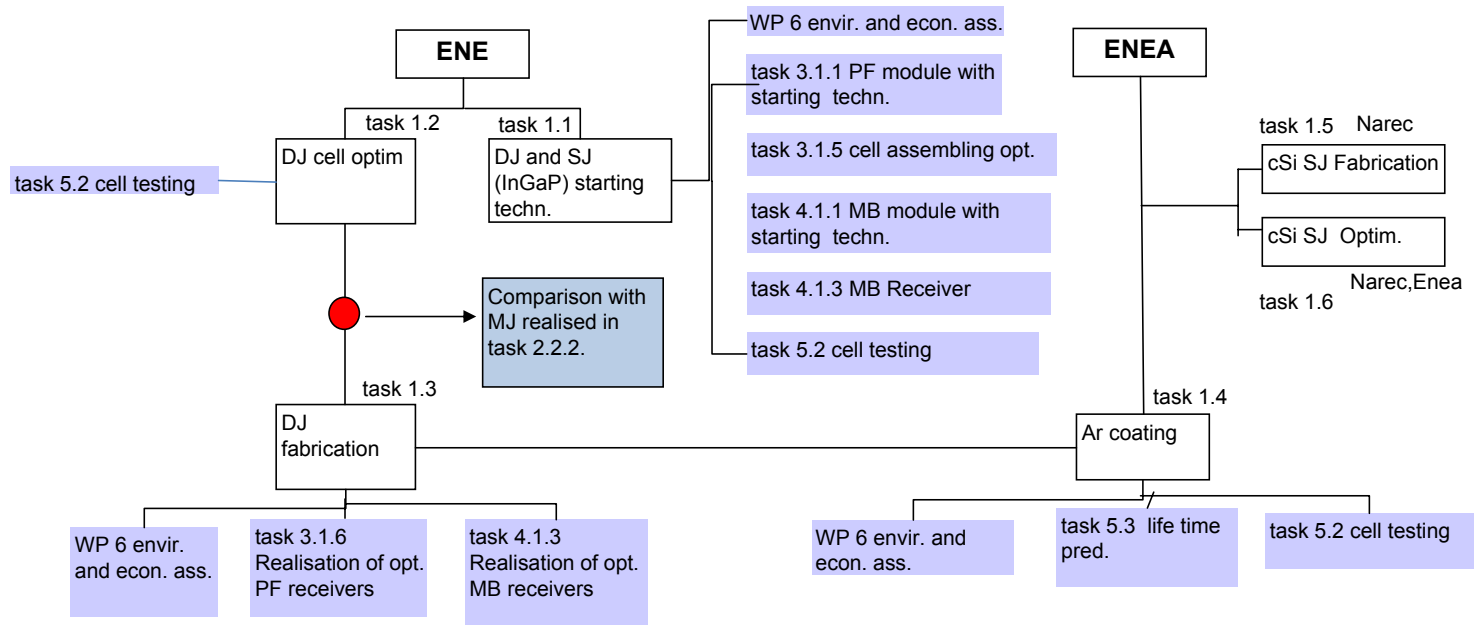
- a.** LGBC silicon cell will be optimised to enhance the IR part of the solar spectrum response
- b.** Solar cell with infrared response enhancement suitable for ultrasonic with 20% efficiency at 100x and process yield of 95% (M24)

1.6.3 Optimisation of cSi cells (ENEA)

- a.** the best choice in terms of optimization, back and front surface passivation low/high resistivity silicon substrates mainly on FZ substrates, but the potential for the use of CZ substrates will also be explored
- b.** Development of new cell structures, characterizations, tests, modelling and simulation under concentrated light
- c.** Development of front contact technology and simplifying the photolithographic steps



WP1-Flow Chart





WP1- Objectives (summary)

- 1. Supply state of the art SJ InGaP, DJ InGaP/InGaAs and cSi to define the system performance baseline (at project beginning)**
- 2. Develop cost effective ~20% efficient at 100 sun LGBC Si concentrator cell for an optimised use in the infra-red illumination for MBS , modified to be assembled in an automated assembly operation**
- 3. Increase e DJ InGaP/InGaAs efficiency for MBS and for high concentration Point Focus systems, from the present 29% up to 31,5% at 750 suns with an enhanced process yield . Target cost below 0,5EUR/Wp at 10MW/year production level.**
- 4. Improve reliability and stability of the devices (AR coating stability, protection against moisture,etc)**





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**Thanks for
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