

IES CPV Multijunction Solar Cell. 40% efficiency in concentration solar cells

Triple junction concentration solar cells allowing to reach competitive prices for photovoltaic electricity working effectively at high concentration levels.

The triple junction concentration solar cell able to reach an efficiency up to 40% has been developed by the III-V Semiconductors Group at the Institute of Solar Energy of the Technical University of Madrid (IES-UPM).

These cells allow to reach competitive prices of photovoltaic electricity in a scenario that nowadays shows a progressive increase in the price of energy of the 62% since 2004 (source: Eurostat). Photovoltaic solar energy market is expected to be growing by 66% along the next four years.

Technological solution supported by the Technical University of Madrid

Technological solution

Multijunction solar cells are currently the most efficient photovoltaic devices. The Institute of Solar Energy has developed a triple junction solar cell with an efficiency close to 40% at a concentration of 1000 suns. This cell is formed by an upper GaInP subcell, an intermediate GaInAs cell and a lower Ge cell.

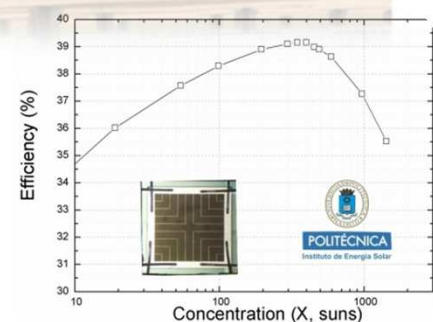
IES-UPM has devoted its wide experience in the field of high concentration to the design of this device. As a result, its performance has been optimized at irradiances higher than 1000 suns, while the impact of the series resistance and the capacity of optimal response to the lack of uniformity of illumination, produced by real optical concentrators, have been minimized.

This solar cell is still at a laboratory prototype stage. Some improvements have already been identified and it is expected to reach efficiencies up to 42% in the near future.

Market implementation sectors

- **Energy:** production of photovoltaic solar energy.

"Triple junction solar cells for concentrations higher than 1000 suns: better performance, more efficiency and competitive prices of photovoltaic solar electricity"



Market needs

- Global demand of energy is expected to grow by 2.2% per year until 2020, mostly in the developed world.
- The price of energy has been increased by 62% since 2004 [Eurostat].
- According to European Directives in the framework of "Europe 2020 Strategy", main objectives to increase energy efficiency are: 20% reduction of energy consumption; 20% of the energy demand of a country supplied by renewable energy sources, 20% reduction of greenhouse gas emissions. [Europe 2020].
- The Sunbelt Countries (Africa, Middle East, Southern Asia and South America) has around 75% of the world's population and 40% global demand of electricity [European Photovoltaic Industry Association – EPIA].

"The demand of electricity is expected to grow by 70% in the coming 15 years, while total demand of primary energy is calculated around 48%"

"Concentration photovoltaic solar energy is identified as one of the sources with the highest margin of potential improvement, driven by technological advances and efficiency gains"

Market potential

- The photovoltaic solar energy industry is currently a growing market: the number of facilities installed has increased more than 48% per year for the period 2000-2012, being Europe the promoter of the 66% of them. [Fraunhofer ISE].
- The estimated average global growth of photovoltaic plants for the period 2013-2017 is 66% [IHS].
- 2013 was a key year in the development of photovoltaic solar industry: installation of 38,4 GW plants, up from 30 GW in 2012. Europe takes a back seat in favour of Asia (China and Japan Photovoltaics remained among the most demanded energy sources in the EU, together with wind energy, in 2013. [EPIA].
- Suncore, Soitec and SunPower lead almost 80% of the global concentration photovoltaics market [IHS].
- Concentration photovoltaic solar energy (CPV) market is expected to increase the current installed power from 358 MW to 1,040 MW in the next 5 years [Global Data].

Competitive advantages

- Efficiency higher than 40% in a triple junction concentration solar cell has been reached: possibility to offer competitive prices of photovoltaic energy. Efficiencies higher than 42% at 1000 suns concentration to be reached in the near future.
- Solar cells prototype manufactured at IES-UPM facilities.
- Reliability analysis of the cell performance by accelerated life tests.

References

- IES-UPM is a cutting-edge R+D center in the field of photovoltaic solar energy, worldwide recognized.
- Broad relationship with industry, innovative career of the research team through collaborative projects, patented results and development of own software.

Industrial protection

- National Patent EP2160555 (on the basis and procedures of solar cells for high concentration).
- European Patent EP2556453 (on the efficiency simulation process used with triple junction solar cells).
- Requested Patent in the USA 2013/0275,095 (on the efficiency simulation process used with triple junction solar cells).

Stage of development

- ☐ Concept
- ☐ Research
- ☐ Lab-Prototype

- ☒ Industrial Prototype
- ☐ Production

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