PHY404- Solid State Physics II

SOLAR ENERGY HARVESTING

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Why are solids interesting?

collective properties
of carriers of electron charge (electrons in conduction band, ions on crystal lattice) and magnetic spins

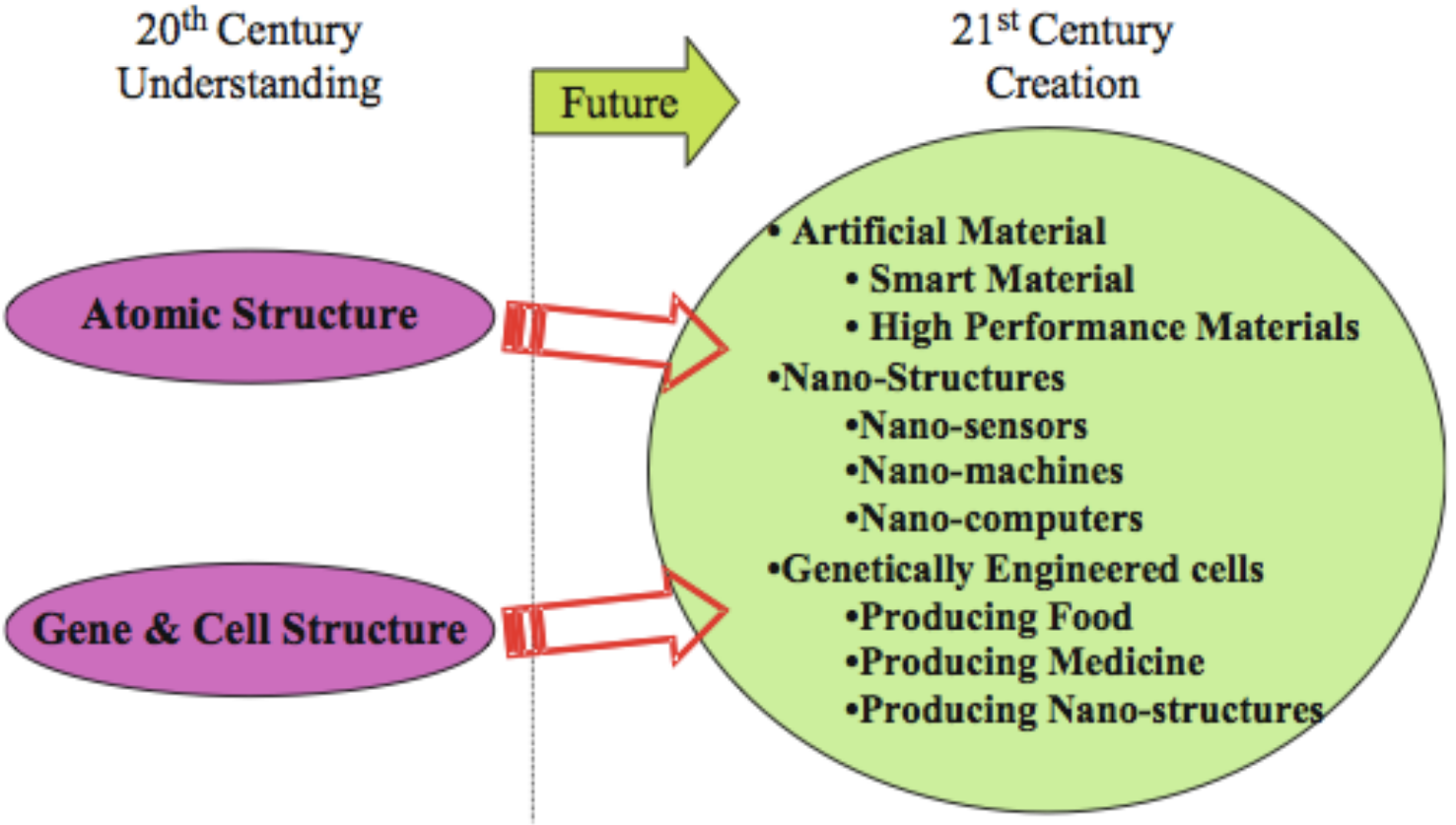
and **excitations & interactions of**
- electronic,
- structural and
- magnetic
degrees of freedom

→ quasiparticles
(e.g. excitations from the superconducting ground state, phonons, magnons, ...)

⇒ **huge variety of physical properties**
corresponding physical quantities vary over many orders of magnitude (electric conductivity, thermal conductivity, optical parameters, magnetic susceptibility)

⇒ **strong interplay with technological appliations**
semiconductor electronics, magnetic or optical data storage, dielectric thin films (optical mirrors, coatings,...), superconducting electronics.

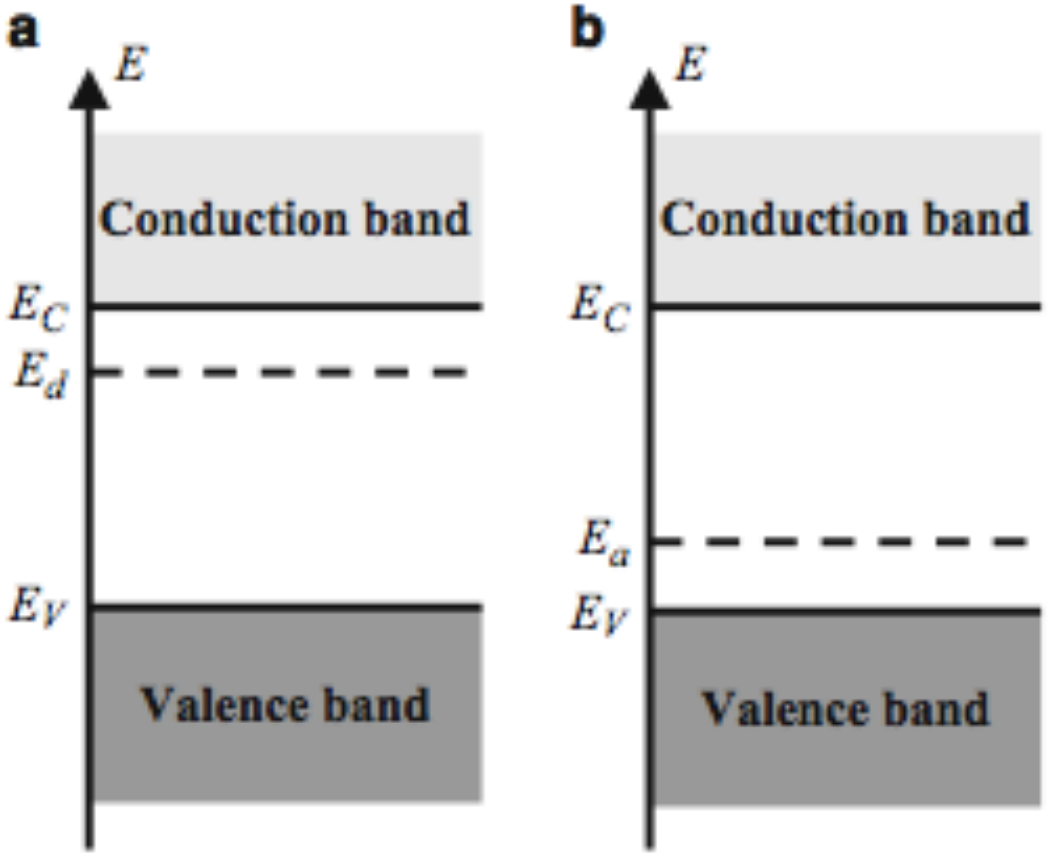
The scientific and technological advances of the twentieth century



Quantum numbers

Orbital	n	l	m_l	m_s
1 *s*	1	0	0	−½, +½
2 *s*	2	0	0	−½, +½
2*p*	2	1	−1, 0, +1	−½, +½
3 *s*	3	0	0	−½, +½
3*p*	3	1	−1, 0, +1	−½, +½
3*d*	3	2	−2, −1, 0, +1, +2	−½, +½
4 *s*	4	0	0	−½, +½
4*p*	4	1	−1, 0, +1	−½, +½
4*d*	4	2	−2, −1, 0, +1, +2	−½, +½
4*f*	4	3	−3, −2, −1, 0, +1, +2, +3	−½, +½

Energy levels of donor and acceptor

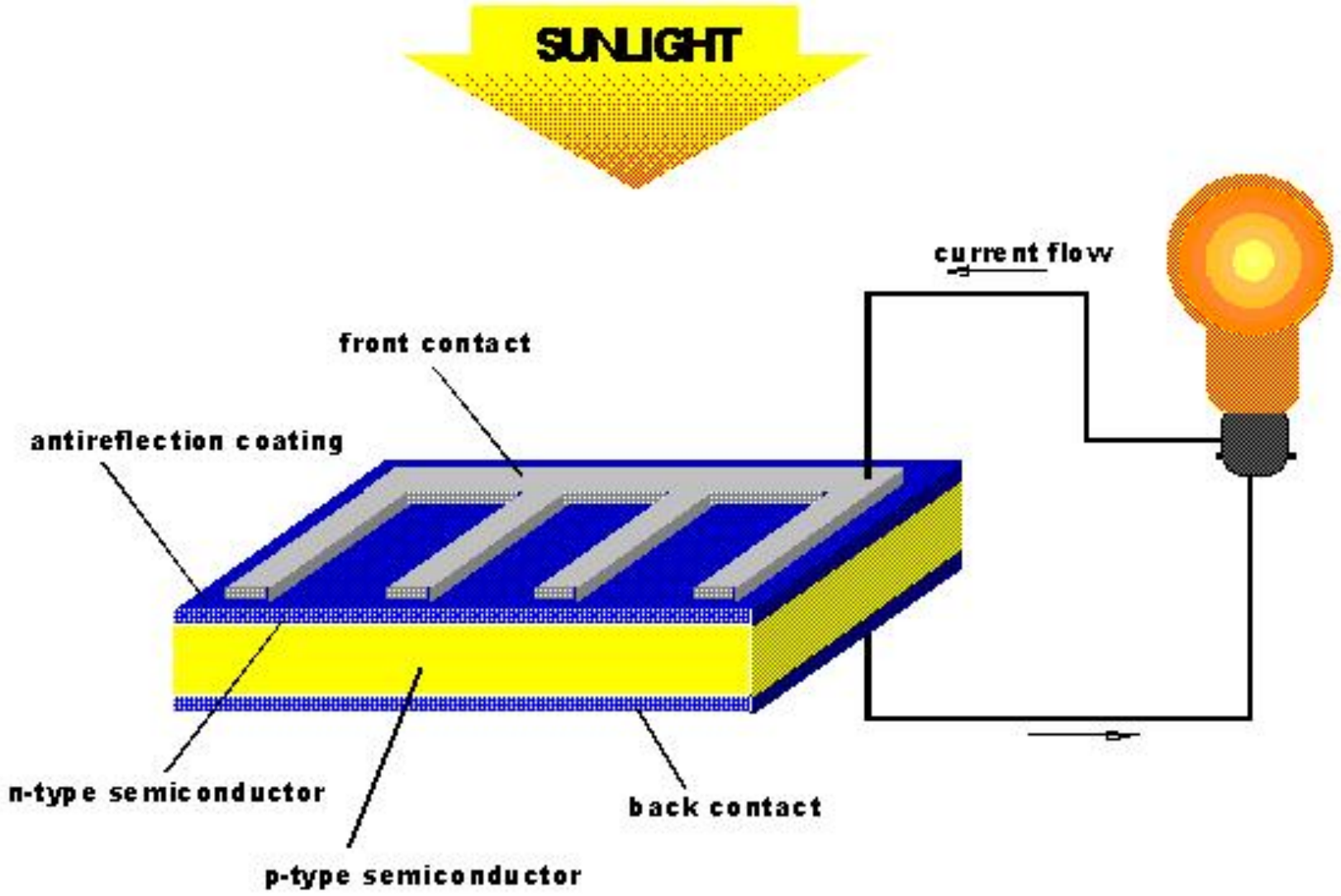


SOLAR ENERGY HARVESTING

- Solar energy is the process of capturing and storing solar energy which is radiated from the sun.

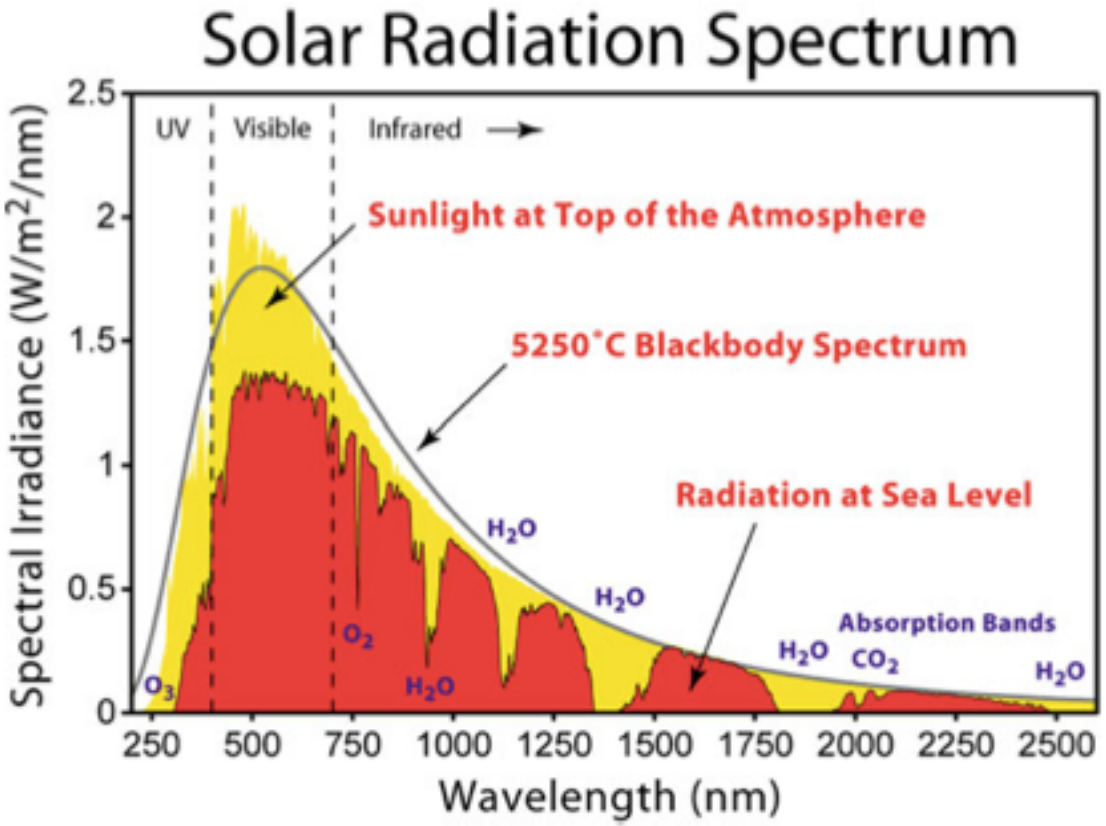
- Then it is converted from light or heat energy to electrical energy by suitable method.

How do solar cells work?

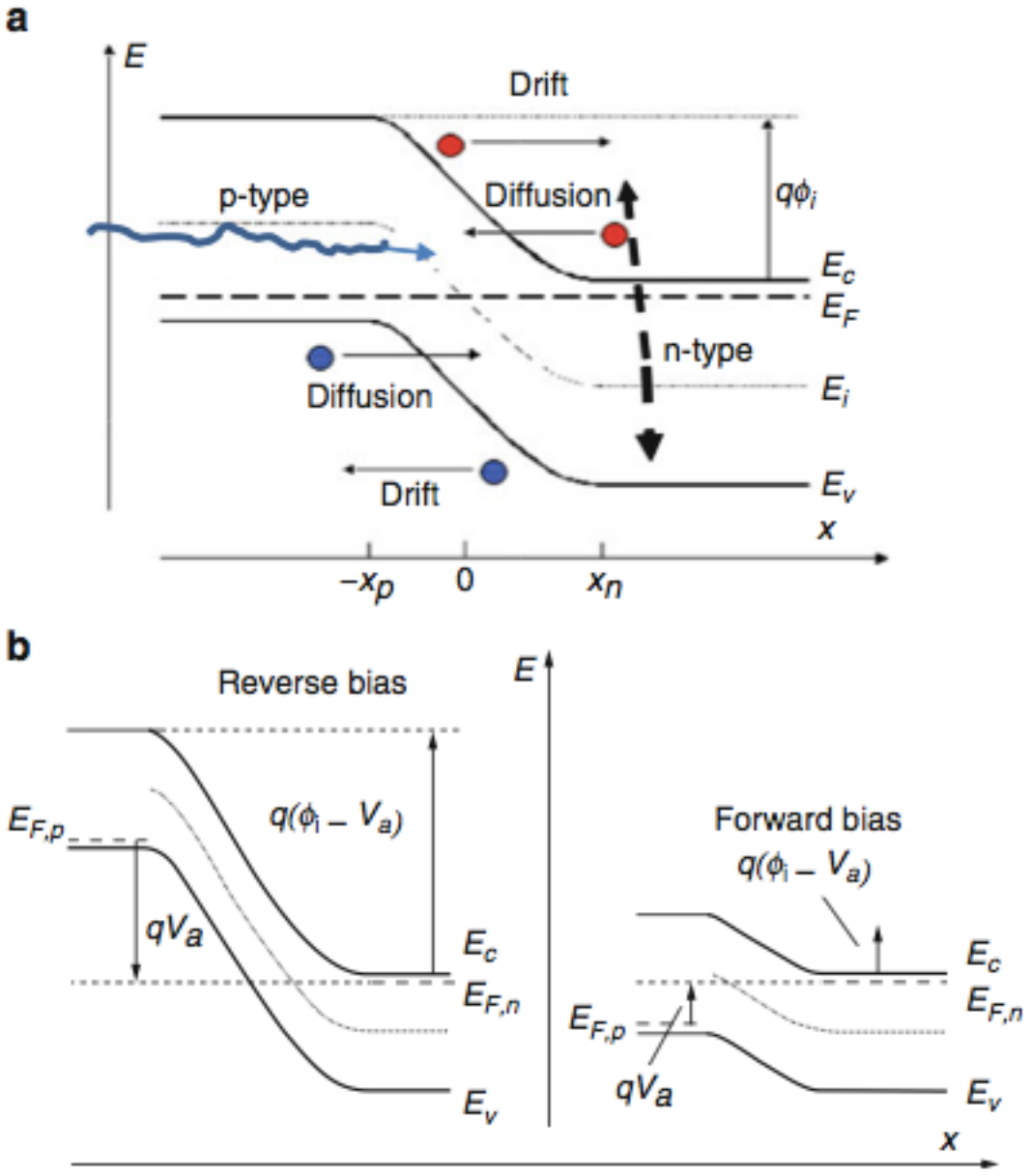


Photovoltaic Cells (PVC)

A part of the sun's energy can also be harvested artificially using photoconductive devices.
This subject and technology has become of supreme importance since the realization that fossils fuels are slowly but surely destroying our planet. The sun emits light over a broad spectrum of frequencies as shown in figure.

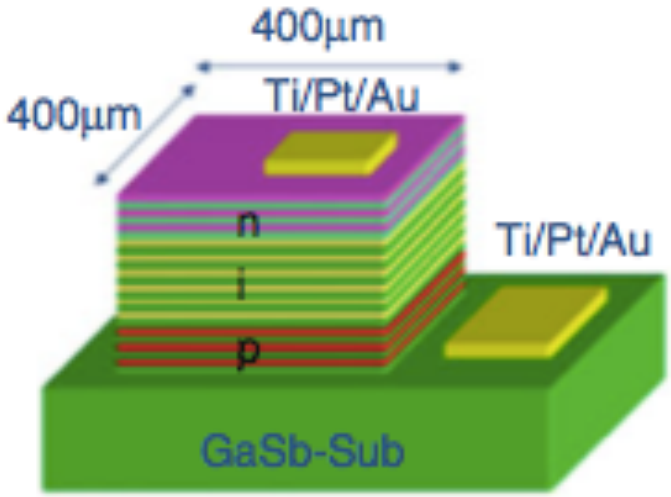


The process of photon harvesting

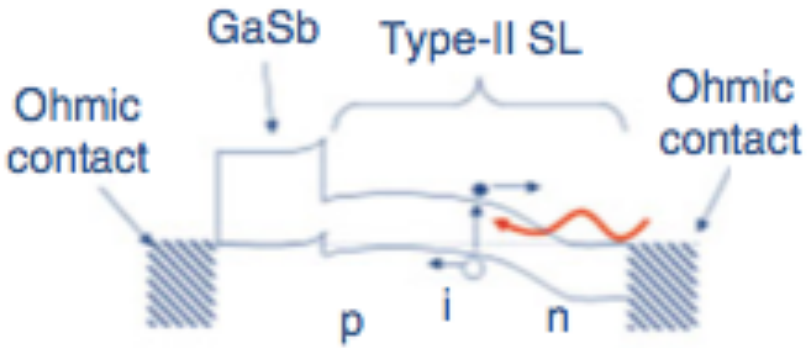


Structure of Type II Photodiodes

Long-wavelength collection (>3 μm) can be done with type II semiconducting devices, which are also used for long-wavelength photodetection.

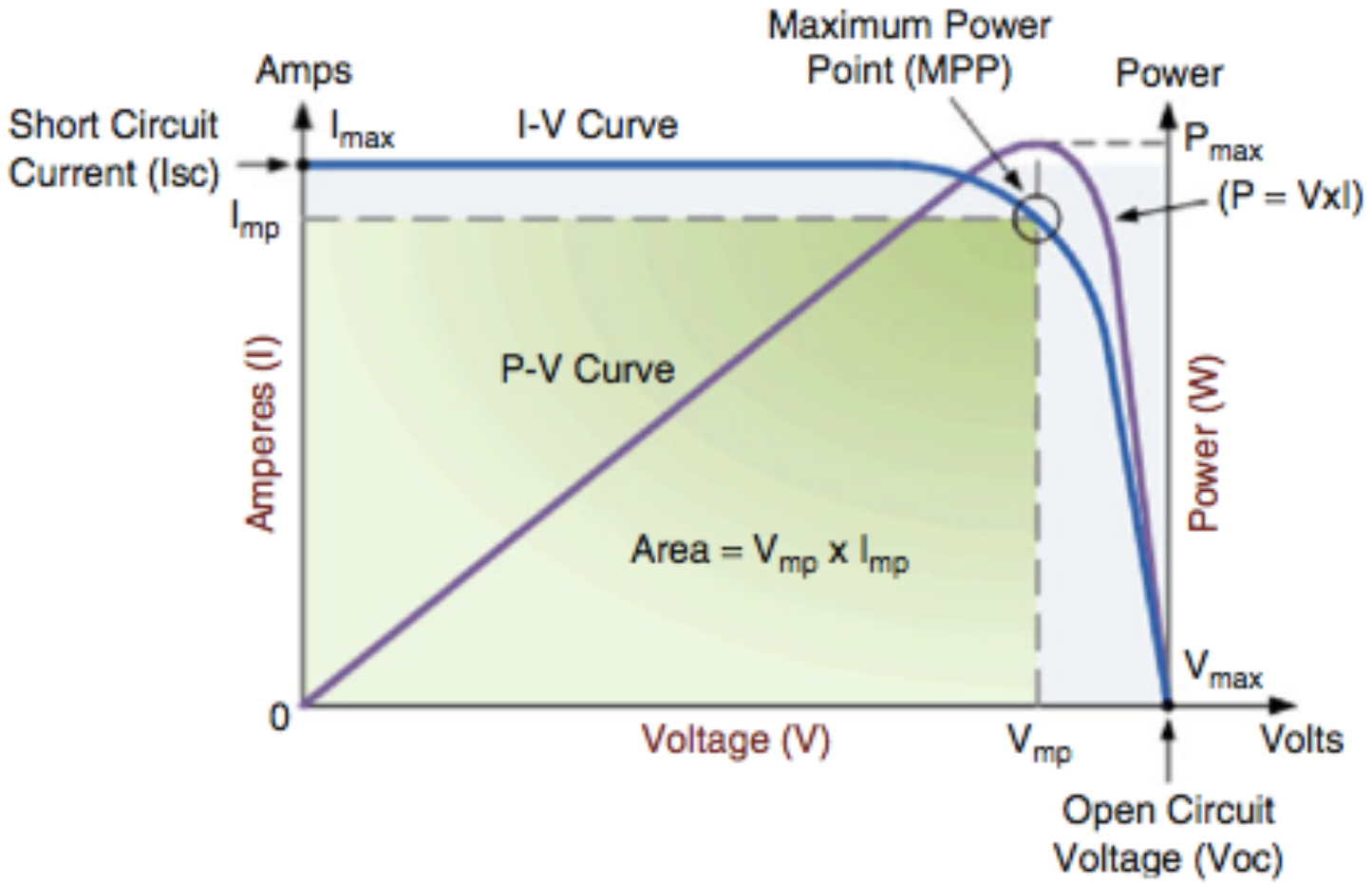


•Schematic Diagram



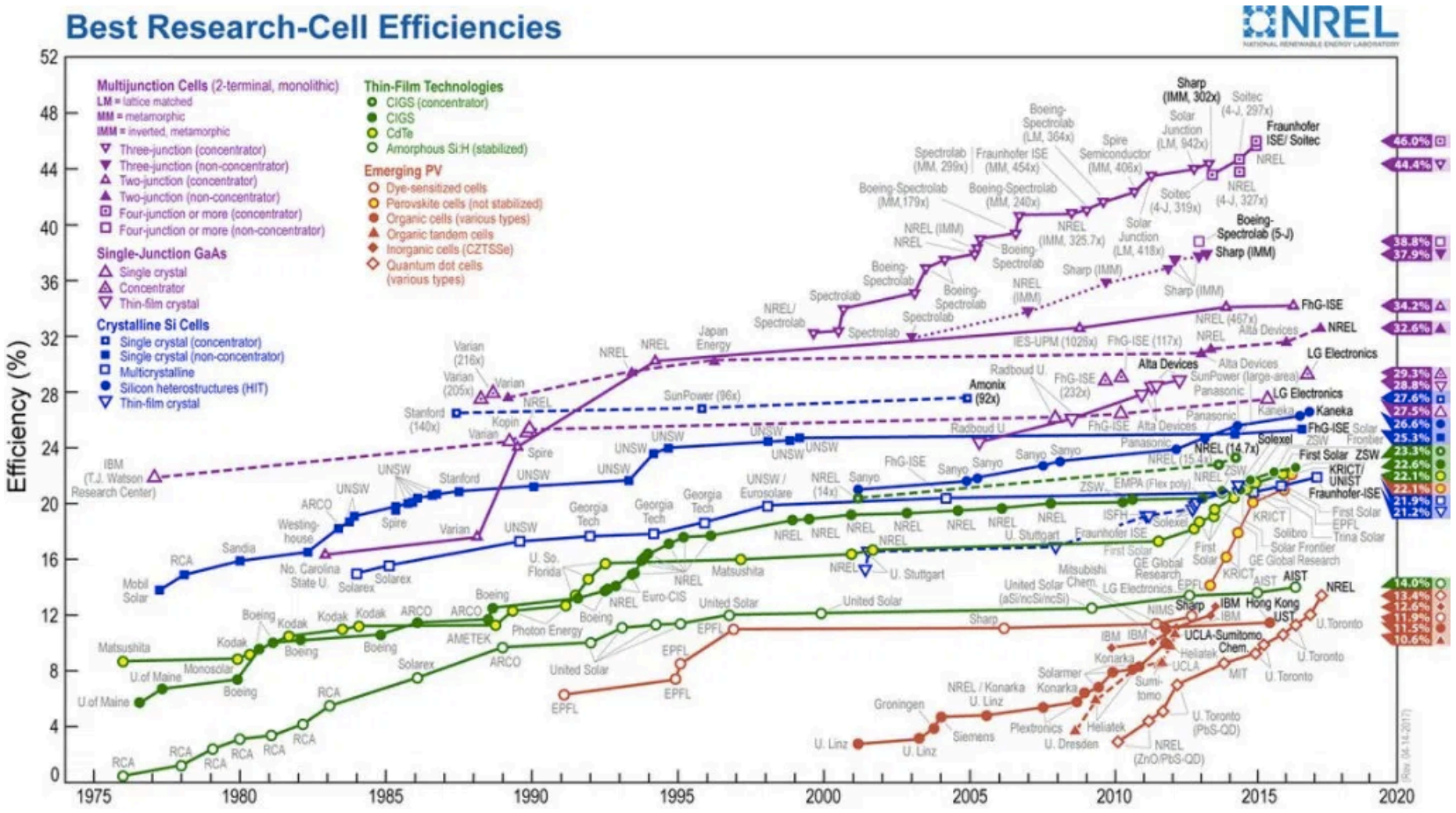
•Principle of Operation

Delaunay PY, Nguyen BM, Hoffman D, Razeghi M (2008) High-performance focal plane array based on InAs/GaSb superlattices With a 10m cutoff wavelength. IEEE J Quantum Electron 44:462–467.



Credgington D, Durrant JR (2012) Insights from transient optoelectronic analyses on the open-circuit cells. J Phys Chem Lett 3:1465–1478

Solar Cell Efficiency



https://www.hisour.com/solar-cell-efficiency-39504/

Solar Cell Efficiency

Solar panel efficiency is a measurement of a solar panel's ability to convert sunlight into usable electricity.

The most efficient solar panels available today are approximately 23%.

Start comparing solar quotes with high-efficiency equipment on the market.