

Photovoltaic (Solar) Cells

How they were made in the 1980's

Short History

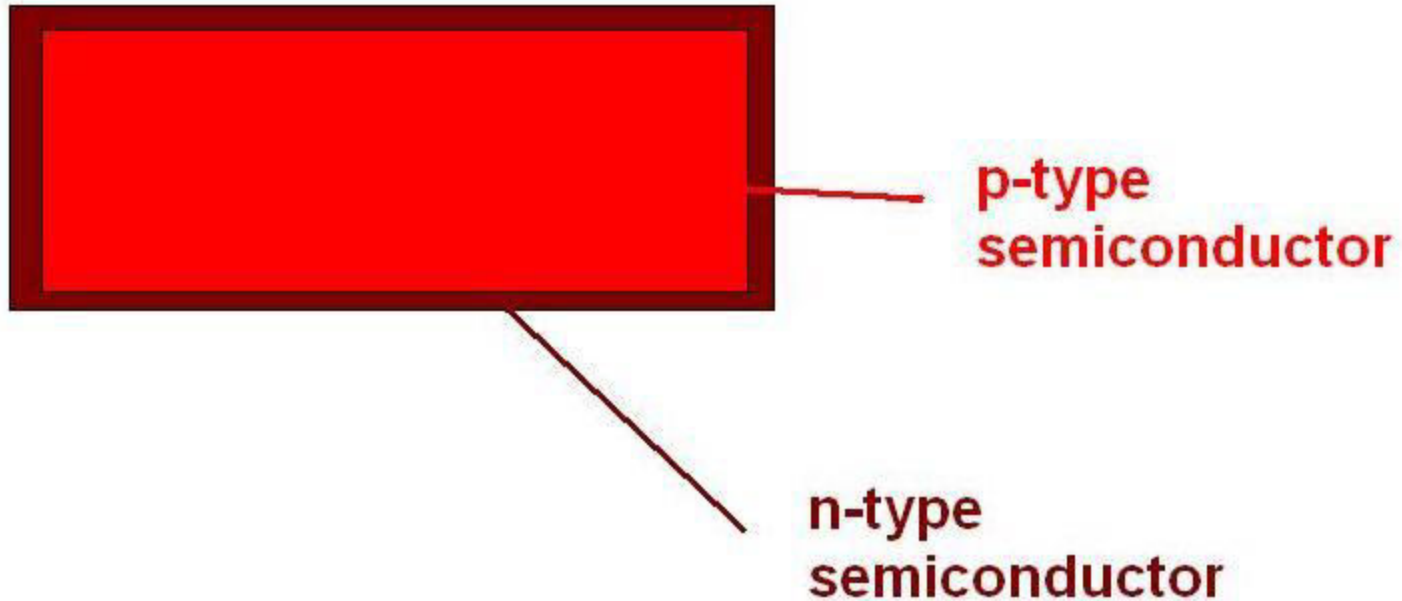
- Photoelectric effect discovered by Hertz in 1887 but remained a scientific curiosity
- Modern cells follow from work by Pearson, Fuller and Chaplin in 1954
- Space age began with Sputnik 1957 and solar cell were ideal energy source

How to make a solar cell

- Start with p-type silicon wafer
- Diffuse phosphorus into this wafer and produce a layer of n-type material round the wafer
- Use photolithographic techniques to define electrodes on front surface
- Plate back surface
- Solar cell can now be put to work

Diffusion

Diffusion of phosphine gas into p-silicon



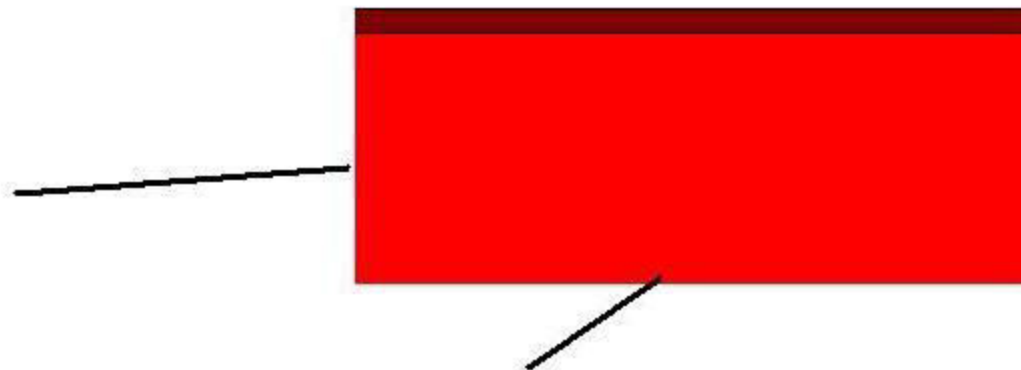
Diffusion Furnace



Trimming

Only upper p-n junction is required

Edge
grind



Sand-blast lower surface

Photoresist added

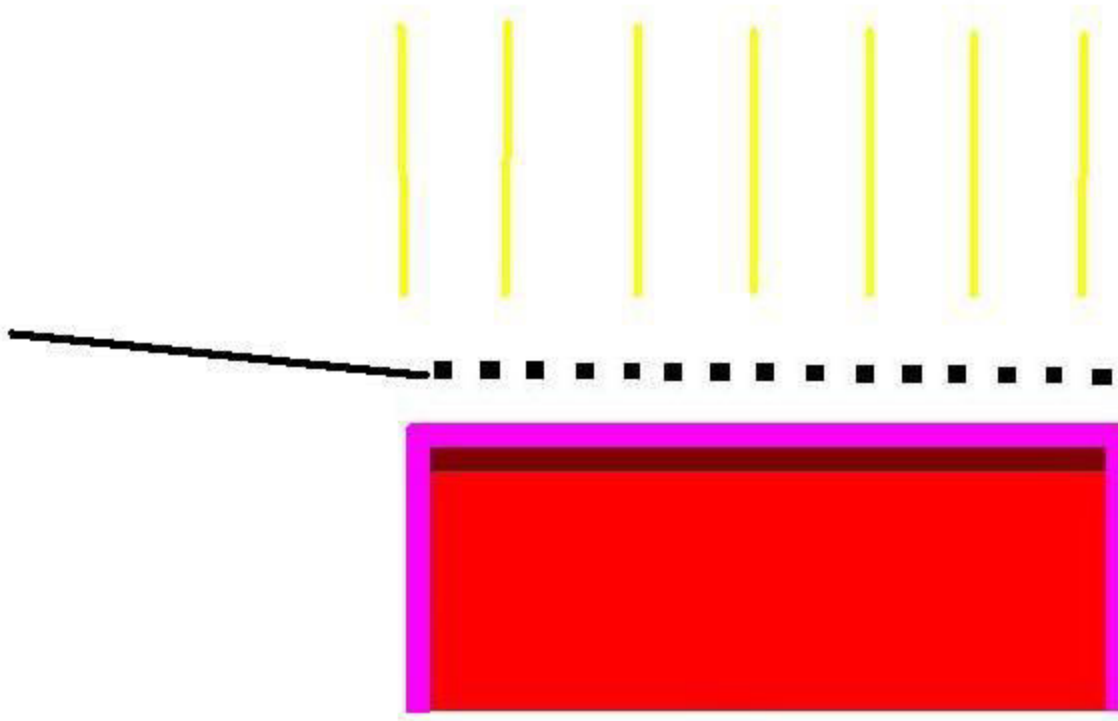
**A photoresist layer is added to the top surface
(and it covers the sides also)**



Illumination

Light shines through mask

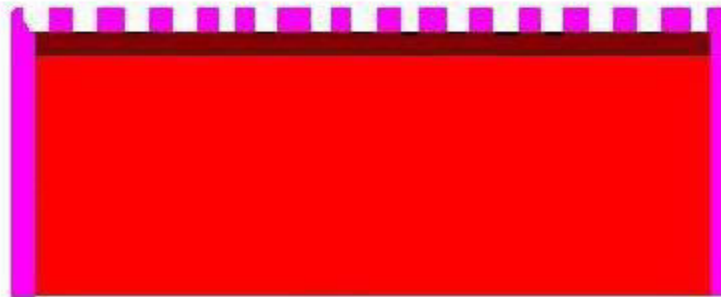
Mask



Front contact defined

Photoresist is cured by light and made mechanically strong

Photoresist is soft in areas under mask and can be rubbed off



Contacts formed on front and back

Electrodeless plating gives metal contact to silicon



Photoresist removed with acidic solution

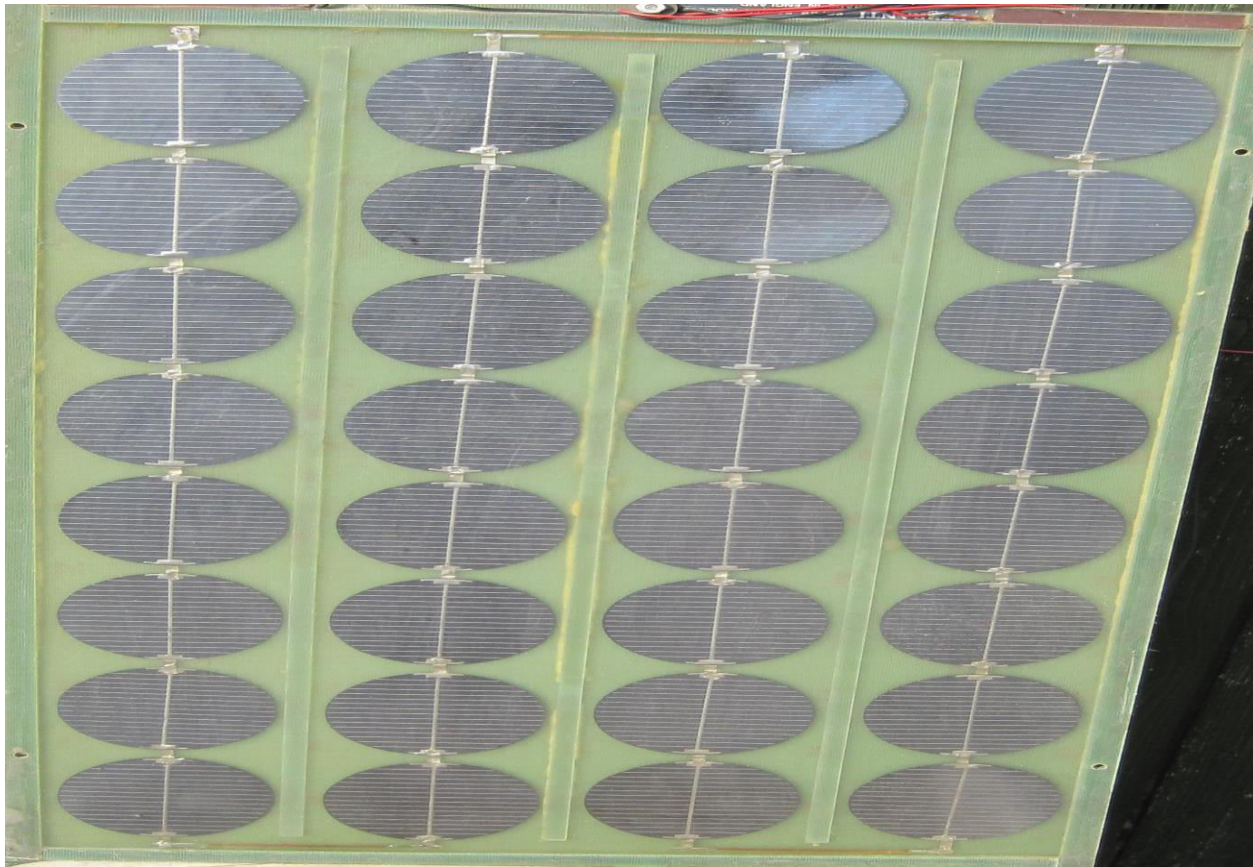
Modules (linking cells together)

- Cell output is about 0.6 volts
- Need to series connect to increase output
- Usually 36 cells connected for a standard battery charging application
- Must provide support for cells

Ferranti PV program

- Solar modules produced in 1960's for space vehicles
- Solar battery charger on Everest expedition
- Started terrestrial program in mid-1970's
(note - with the space program quality was more important than cost **** with terrestrial cells low production costs were required)

Ferranti MarkI

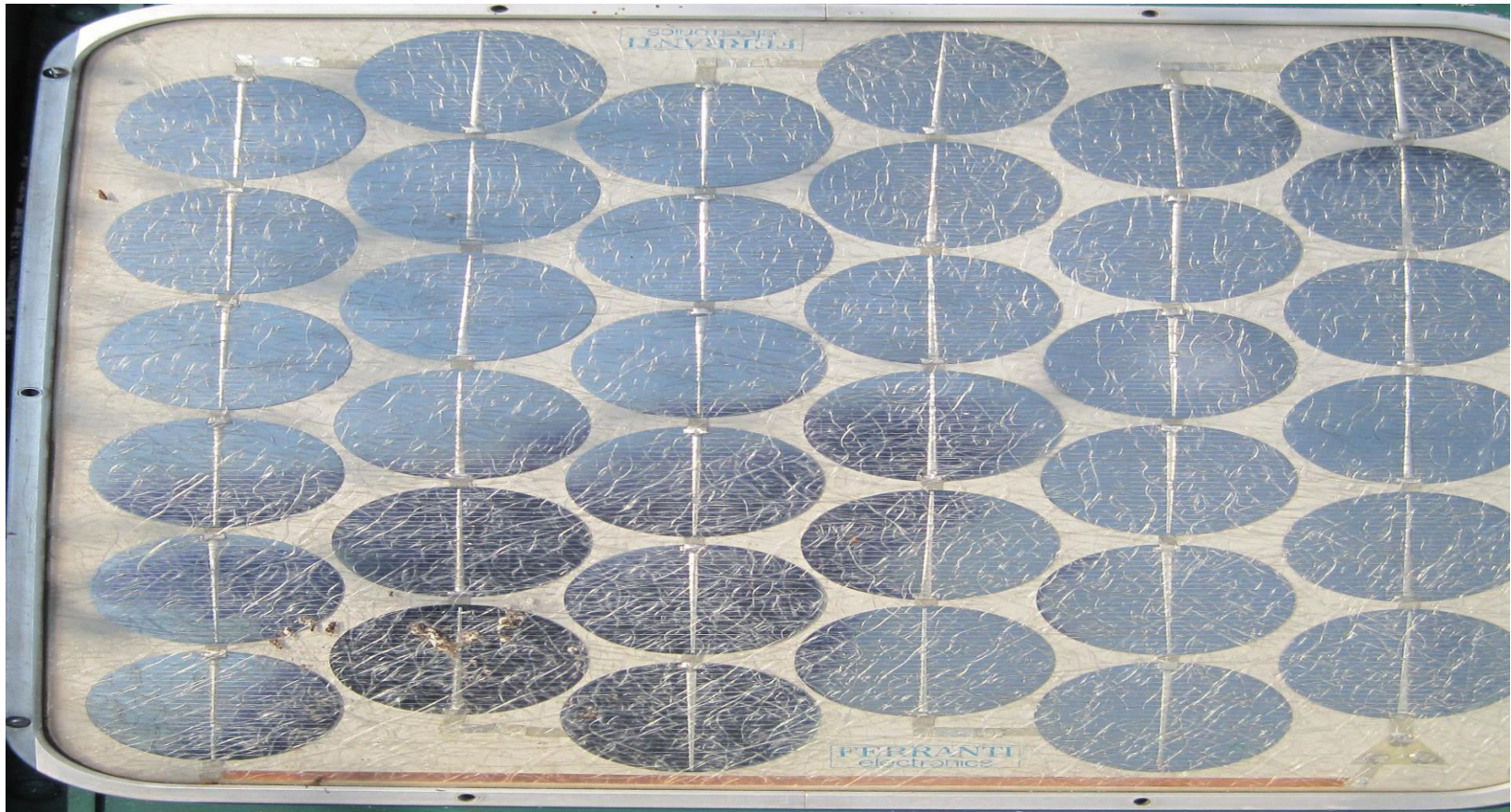


Problems with Mark I

- On plus side – easy to construct
- Link cells, lay in fiberglass tray, pour in transparent gel, harden gel in oven.
- Minus side - flexing of module broke interconnecting tabs. Use ribbon tabs
- BUT Bird life enjoyed pecking gel

Move to MarkII

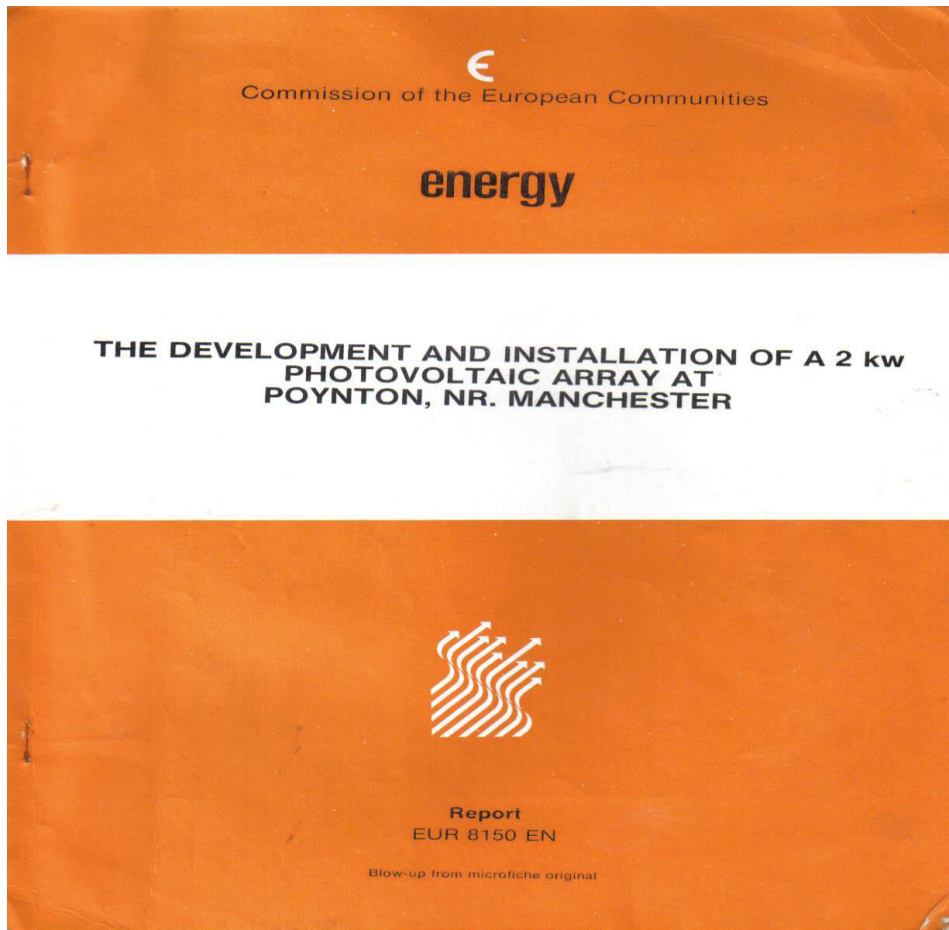
Ferranti MarkII



Confidence in PV Mark II

- Module gave 15 Watts power
- Useful for remote applications: wind monitors, electric fences on farms....
- About 50 modules sold – list price £ 200
- Ferranti were only company in UK making PV panels and so had no competition

European funding 1978

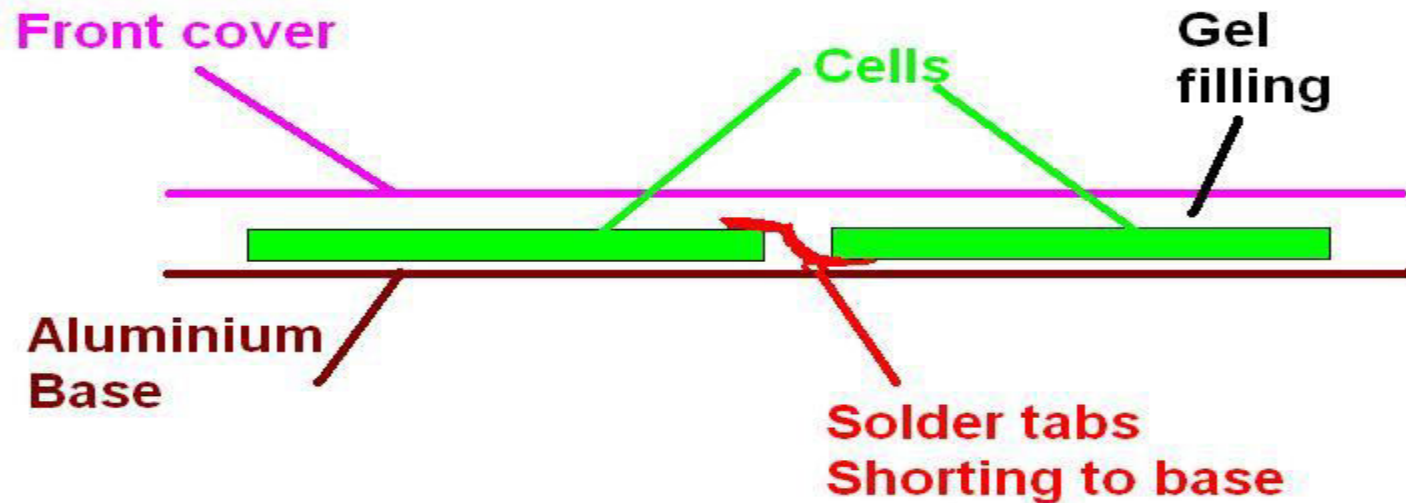


Project description

- PV source (150 modules) to power a radar installation (we were still in a cold war world and many countries were interested)
- All controls and measurements to be computerized (National Semiconductor chip)
- Report to EU Commission after 2 years

Report to EU

Malfunction in modules



Ferranti discontinued PV manufacture

After 20 years of making solar cells this work
was stopped and all the expertise was lost

Module failure had been caused by a minute
but detrimental design feature

One can conjecture that the Ferranti story may
have been very different if the Poynton
project had been a success

PV's have a bright future

- Green energy – utility companies have to generate a certain % of “green”.
- Huge areas in North Africa could be used for solar farms
- Water pumping in developing countries
- Electrical output of PV's adds to adaptability (hydrogen economy)

Closer to home

