

Current and Future PhotoVoltaics

Dr Darren Bagnall, Southampton University

Contents

- Current status of photovoltaic technology
- 1st generation devices
- 2nd generation devices
- 3rd generation devices and new technologies
- Conclusions

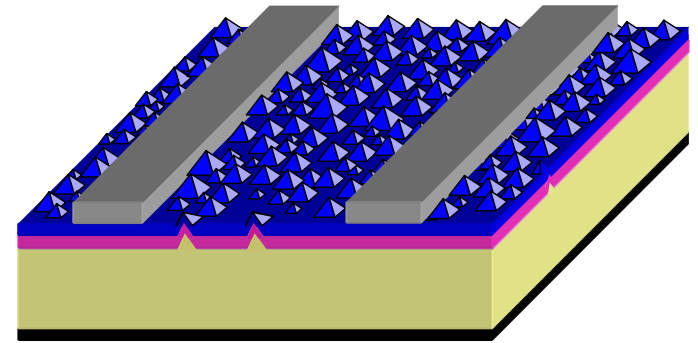
Important Considerations

- £/W is the most important figure
- this includes manufacture, installation, maintenance
- £15K installation for a house is **x 4** too much
- currently device fab. is most of cost



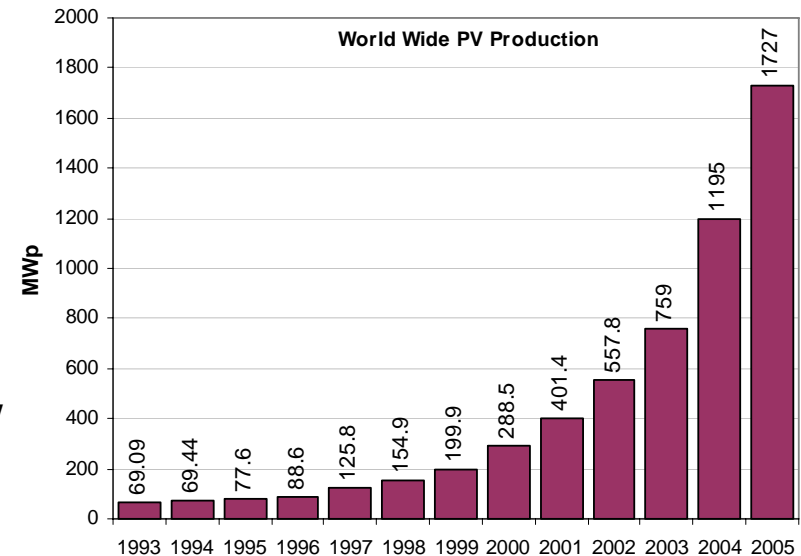
“First Generation” Devices

- Built into wafer silicon
- Single crystal Si (~**20%** efficient)
- Multi-crystalline Si (~**15%** efficient)
- ~ **30%** maximum efficiency
- **95%** of a billion dollar industry that exists through subsidy



Routes to lower £/W ?

- half of cost is the silicon wafer
 - thinner/cheaper substrates
- up-scaling production
 - bigger factories, shared know-how
- use of new technologies for higher efficiency at low cost

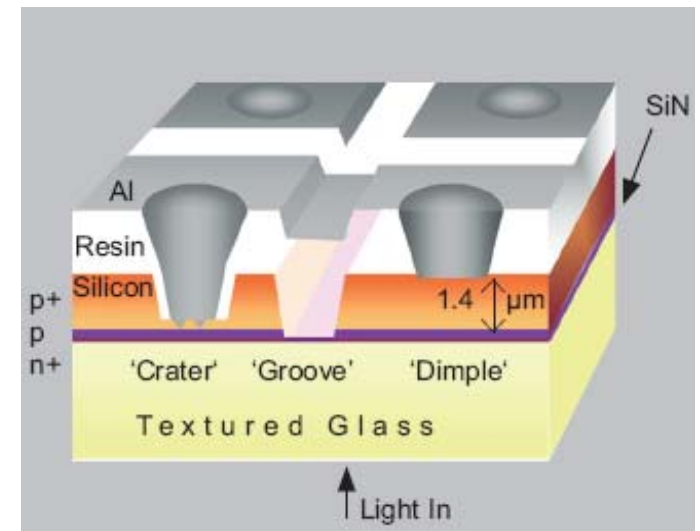
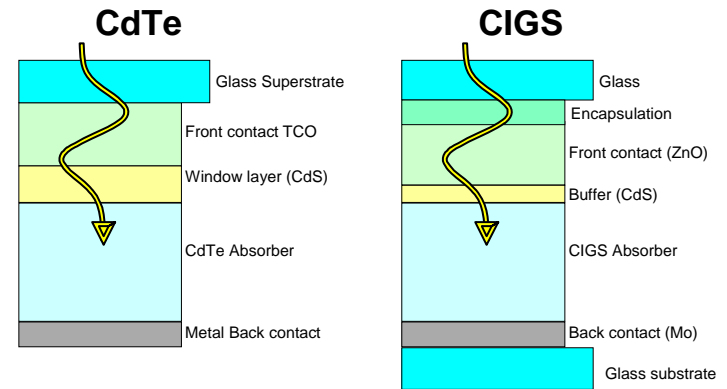


“Second Generation” Devices

- based on high absorption semiconductor thin films
- in principle, less material cost
- CuInSe_2 (12%)
- CdTe (12%) } **too expensive**
- a-Si (<10%) **degrades**
- organic semiconductors (4%)
- poly-Si (with light-trapping) (10%)

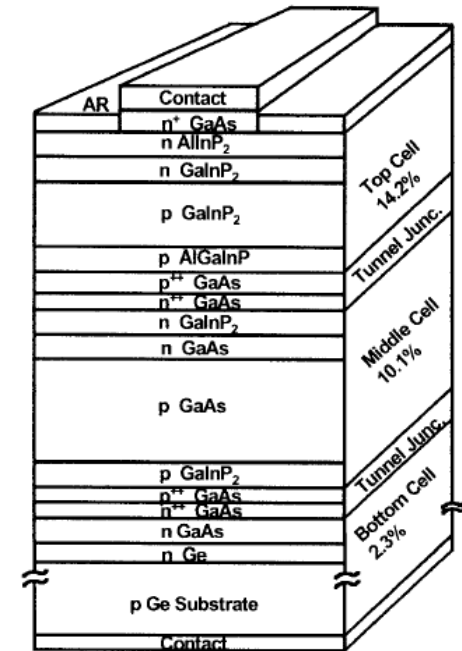
Challenges

- light-trapping (photonics?)
- better material properties



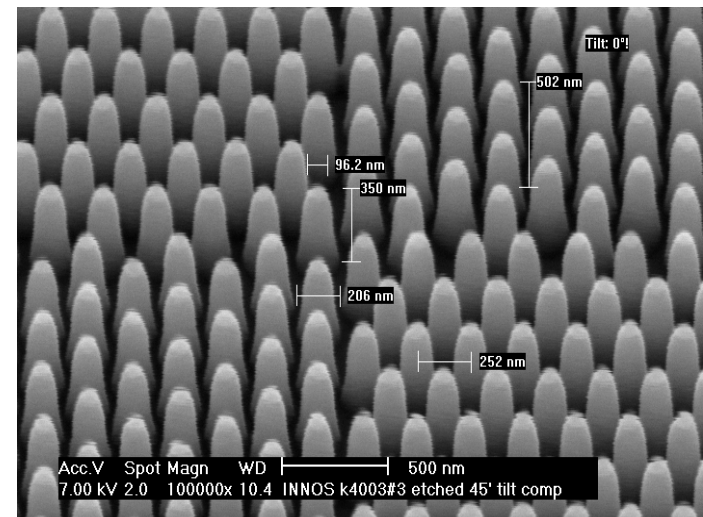
“3rd Generation” and new technologies

- **3G techniques** to raise efficiency (allow > 30% efficiency)
 - more than one junction
 - photon conversions
 - photon management
- **new technologies**
 - could capture more light
 - use much less material
 - cheaper to produce



challenging but we now have

- nanotechnology
- photonics, plasmonics
- organic semiconductors



Conclusions

- Photovoltaics is at least 4 x too expensive
- However, 1st generation scale-up
 - + new technology tricks could reduce cost by 50%
- At same time other energy supply will become more expensive
- **By 2025 photovoltaics will be cost competitive**
(home owners will think £5K is good value for energy independence)
- This could be much sooner than 2025 with investment
(or if other energy supplies increase rapidly)
- Meanwhile, nanotechnology, plasmonics, photonics,
offer real chance for fundamentally new devices
- **PV will become an important part of UK energy portfolio**