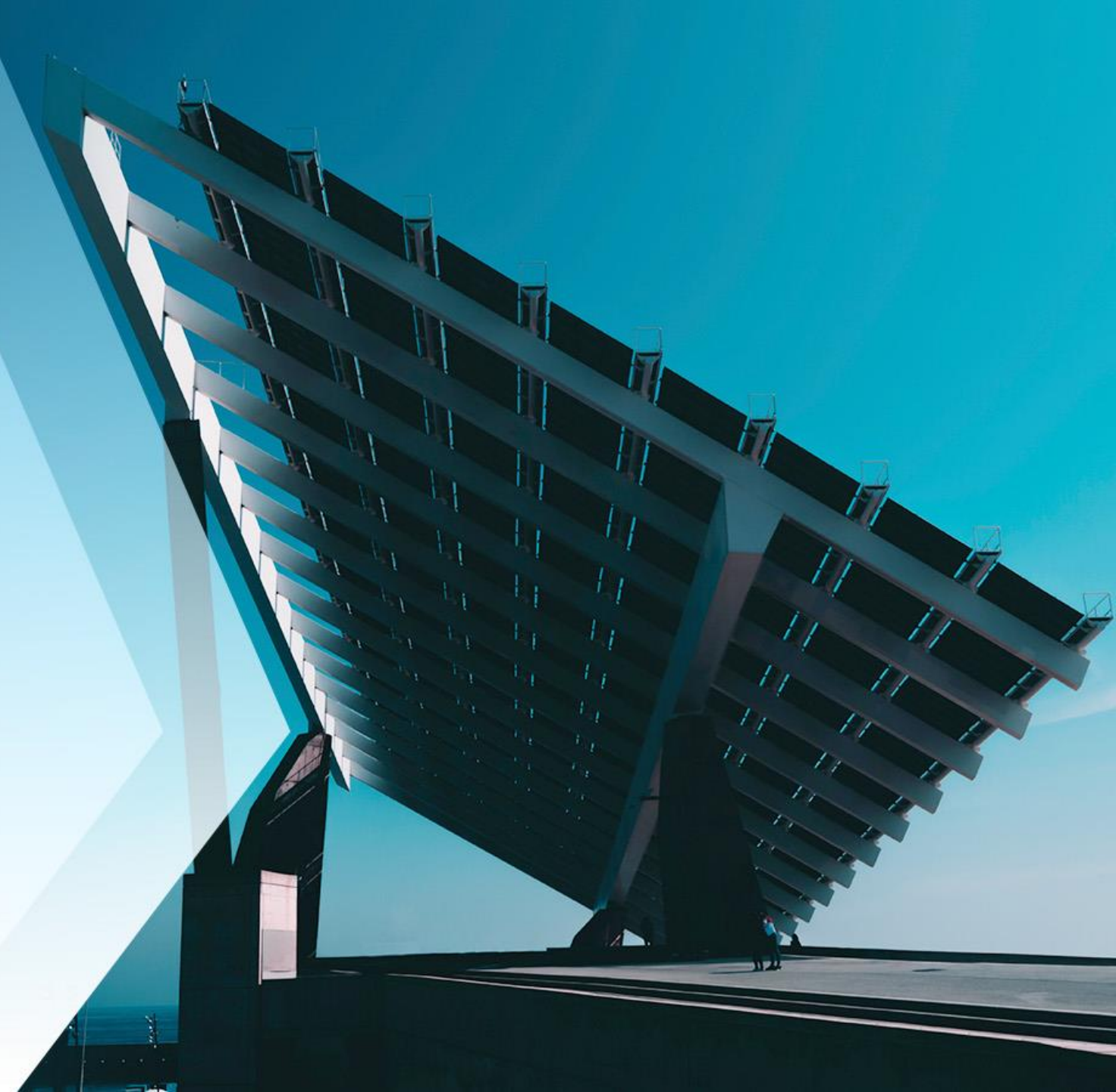
Comparison of planar and textured silicon solar cell



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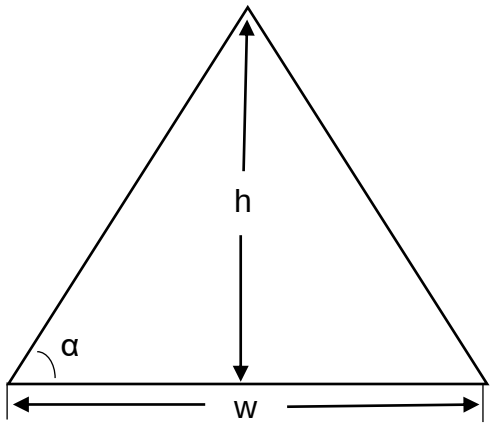
CONTENT

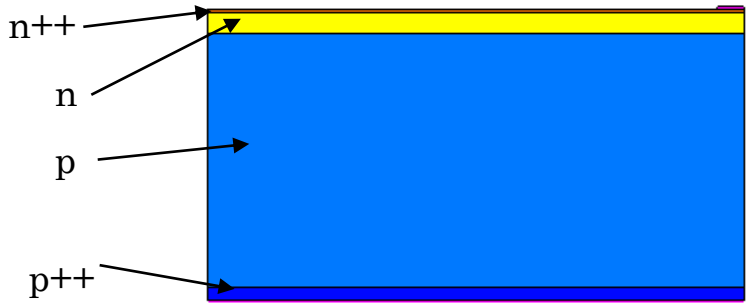
Planar and textured silicon solar cell

Silicon based heterojunction solar cells

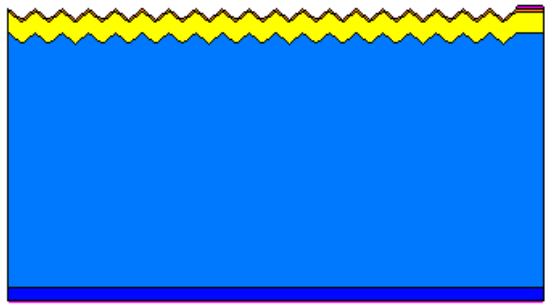
GEOMETRIC MODEL



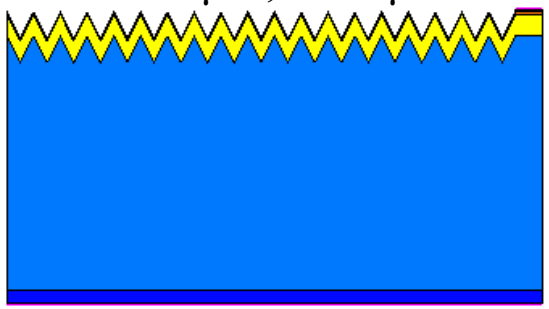
h – height, *w* – width, *α* – angle of base of pyramid



α=0



h=0.4 μm, w=1 μm

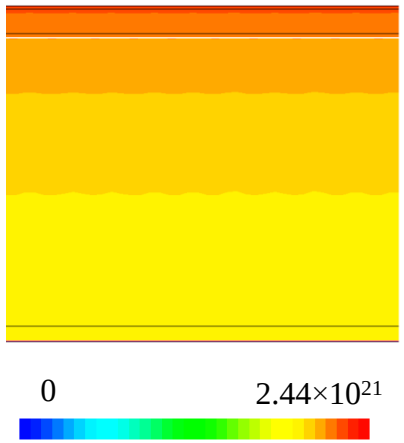


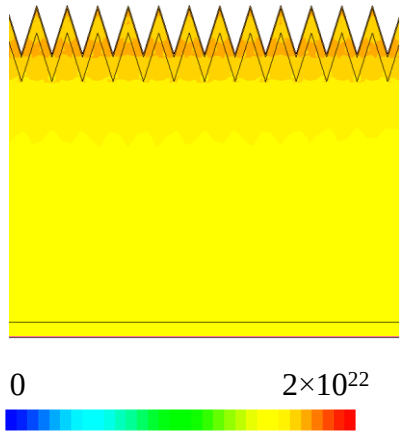
h=1 μm, w=1 μm

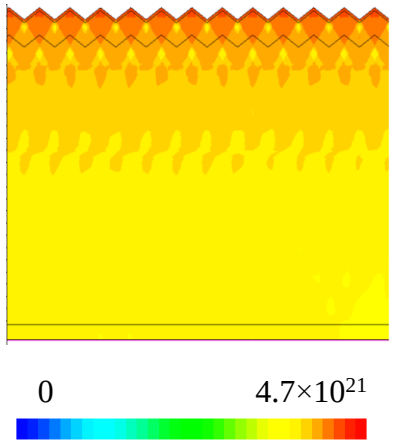
Tool Command language codes

```
(do ( (i xk (+ i wt1)) )
          ( (> i xty1) )
          (begin
            (sdegeo:insert-vertex (position i (/ dn 10) 0))
            (sdegeo:insert-vertex (position i (/ dn 5) 0))
            (sdegeo:insert-vertex (position i dn 0))
            (display i) (newline)
          )
)
 (do ( (i xt01 (+ i wt)) )
          ( (> i xty1) )
          (begin
            (sdegeo:move-vertex (car (find-vertex-id (position i
  dn 0)))(position i (+ dn ht) 0))
            (sdegeo:move-vertex (car (find-vertex-id (position i
  (/ dn 5) 0)))(position i (+ (/ dn 5) ht) 0))
            (sdegeo:move-vertex (car (find-vertex-id (position i
  (/ dn 10) 0)))(position i (+ (/ dn 10) ht) 0))
            (display i) (newline)
          )
)
```

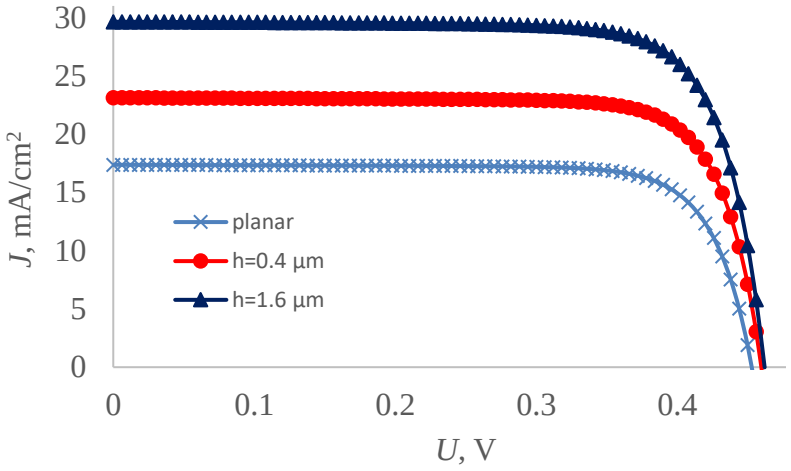
INFLUENCE HEIGHT OF PYRAMID ON PHOTOELECTRIC PARAMETERS

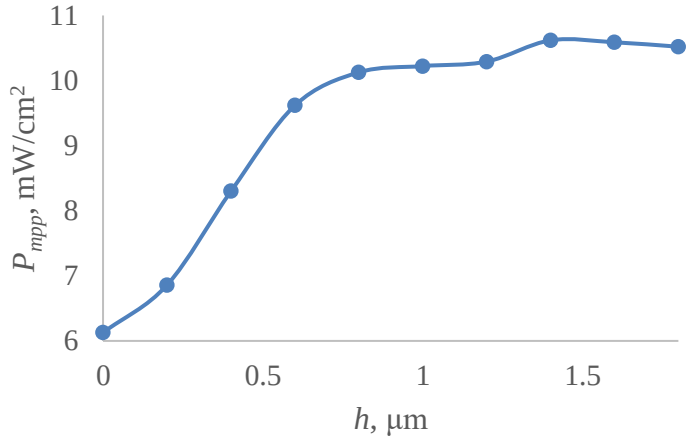


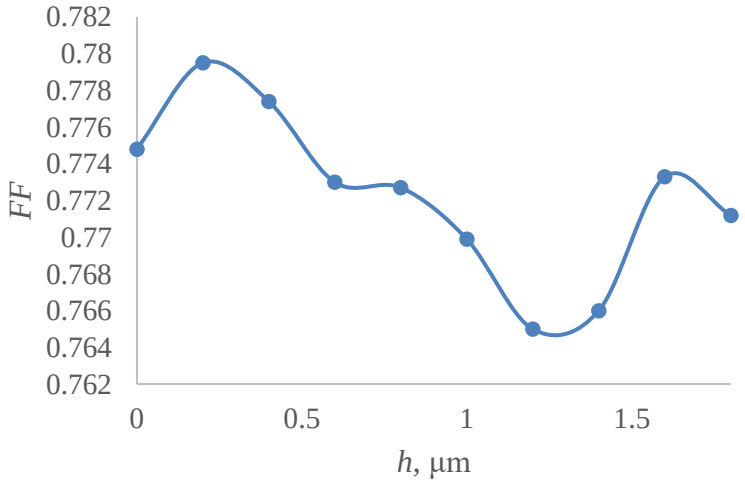




Distribution of photons which are absorbed in silicon-based solar cell





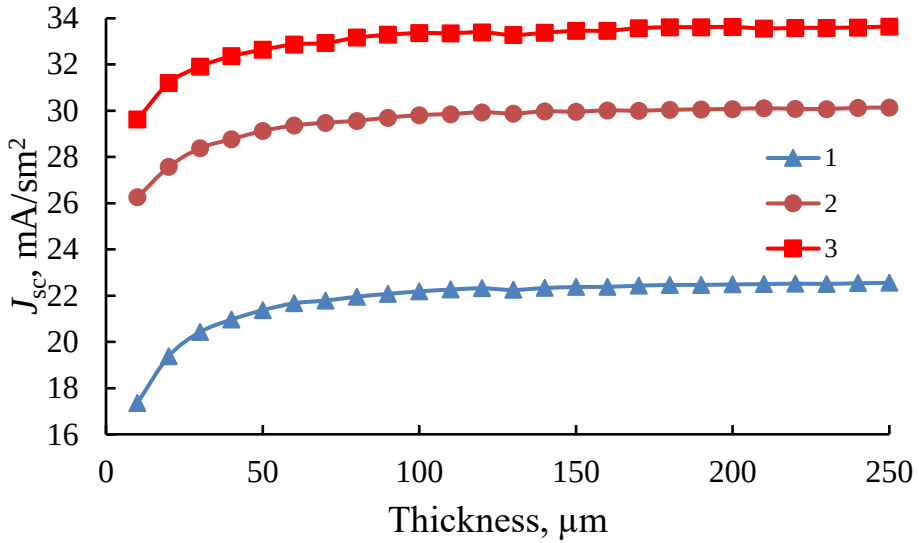


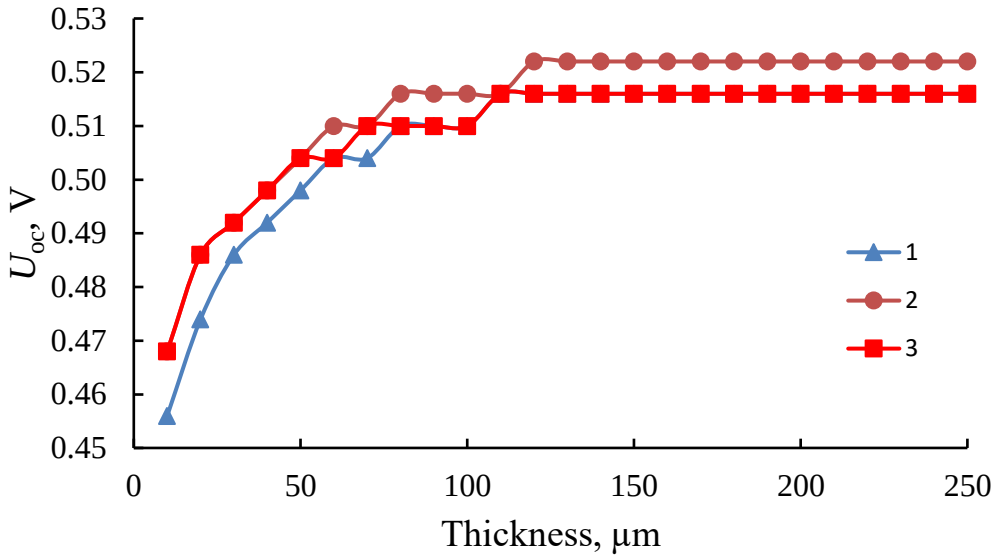
Findings

The best sizes of pyramids.
In simulation:
h=1.4 μm, w= 1 μm, $a=70.35^0$
In theory of optics:
$a=73.12^0$

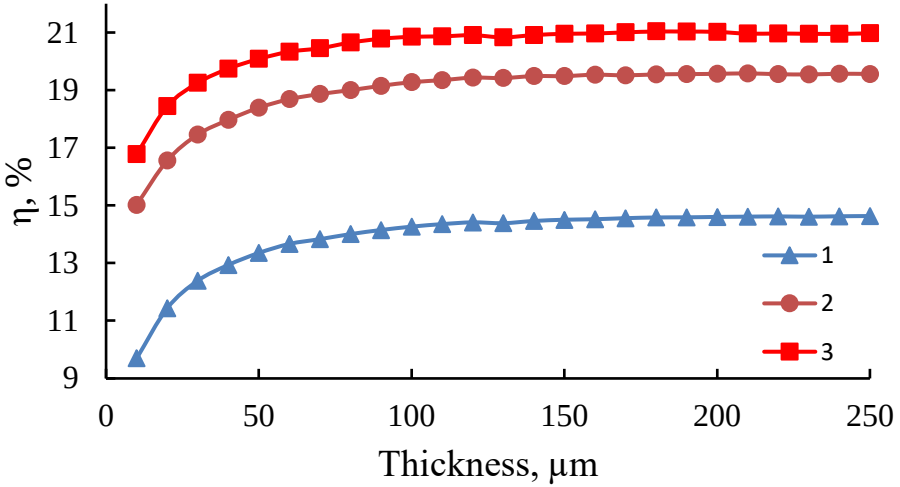
*Efficiency of textured solar cell is **1.6 times** greater than efficiency of planar silicon solar cell*

THICKNESS





1 – planar, 2 - α=54°, 3 – α=70.4°

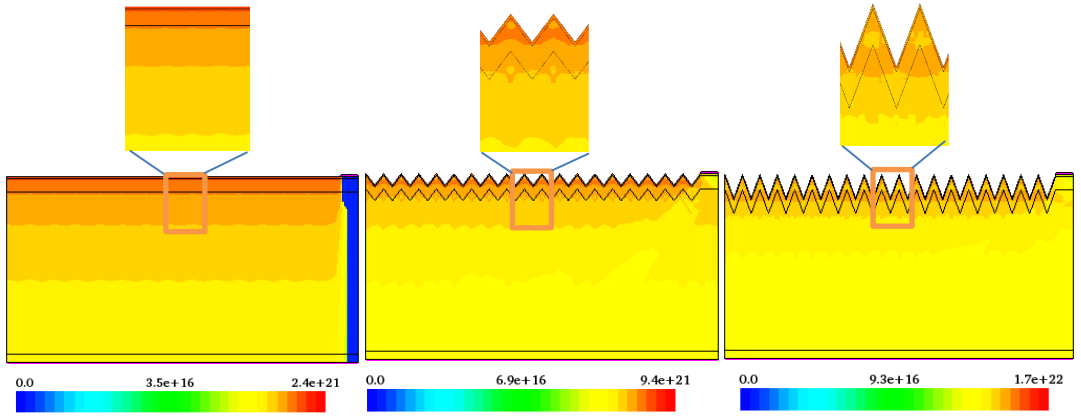


Findings

A solar cell (70.4°) with a thickness of 40 μm can reach 19.56% of the efficiency of a textured silicon solar cell (54°) with a thickness of 250 μm.

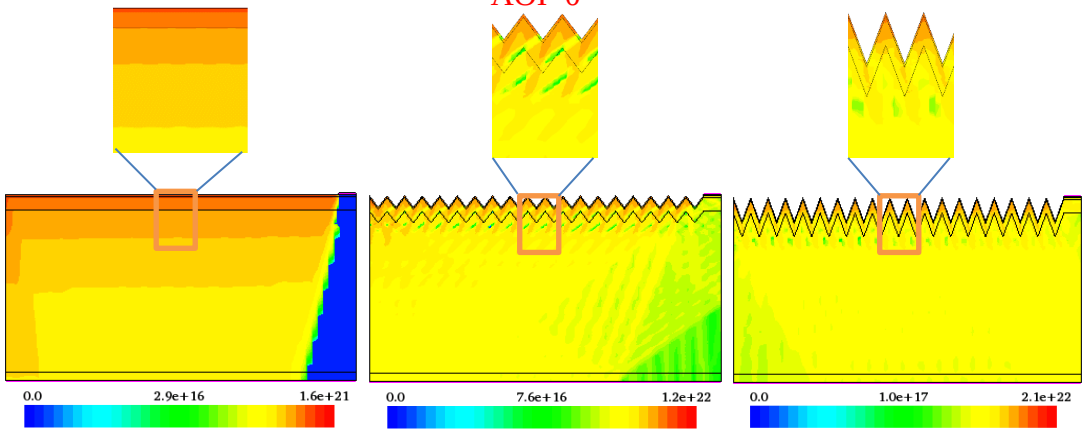
We can reduce its cost by a factor of five.

ANGLE OF INCIDENT LIGHT



planar *a=50.4⁰* *a=70.35⁰*

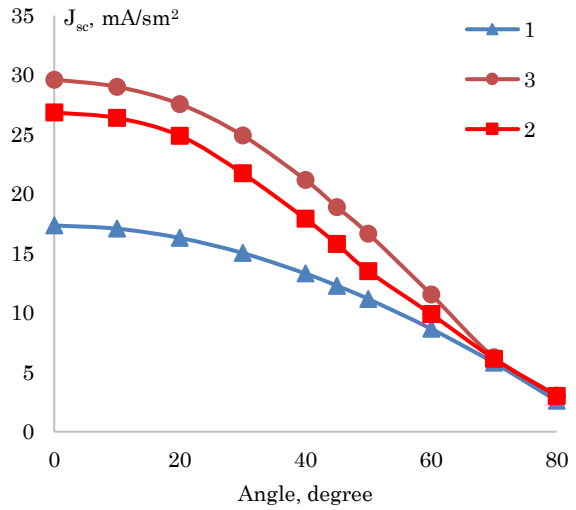
AOI=0⁰

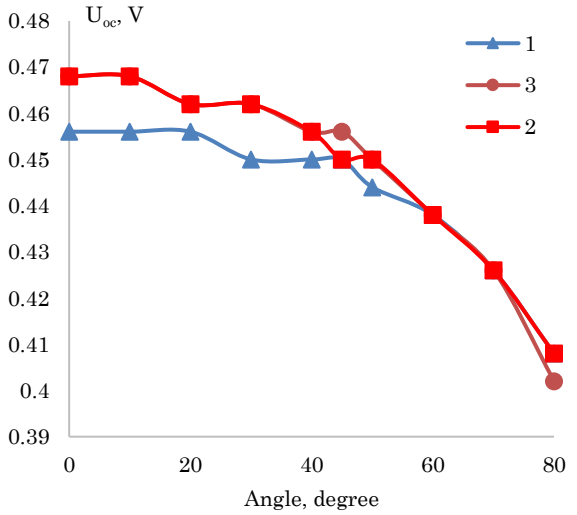


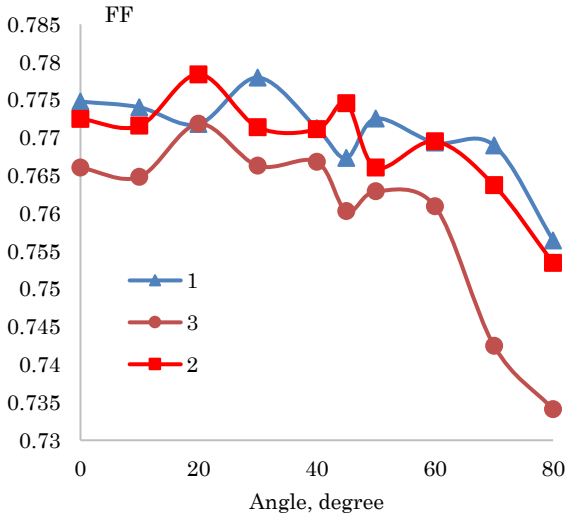
planar *a=50.4⁰* *a=70.35⁰*

AOI=50⁰

Absorbed photon density

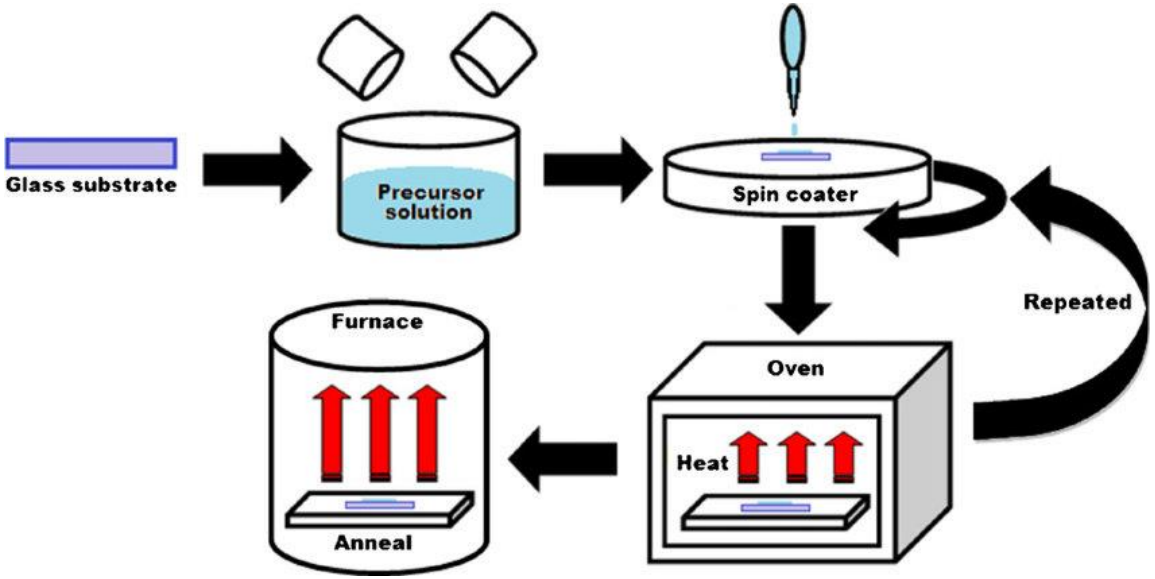


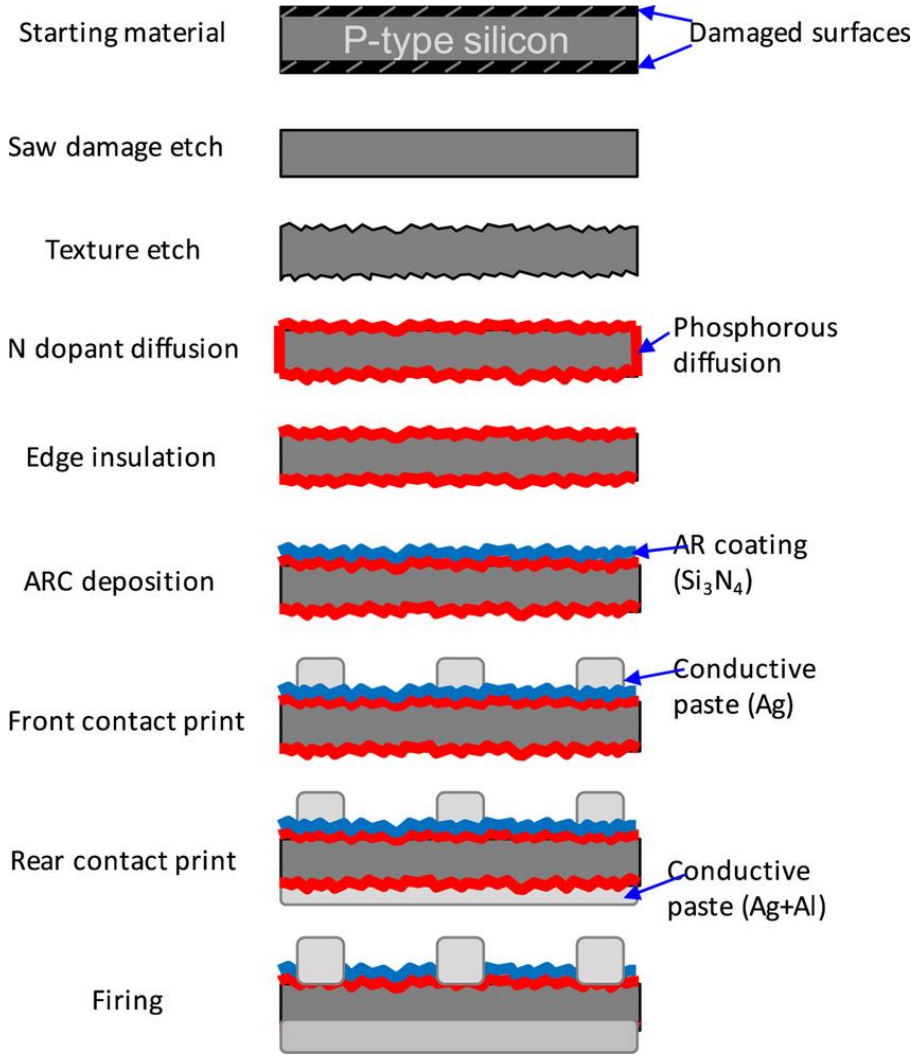




1 – planar, 2 - *a*=54°, 3 – *a*=70.4°

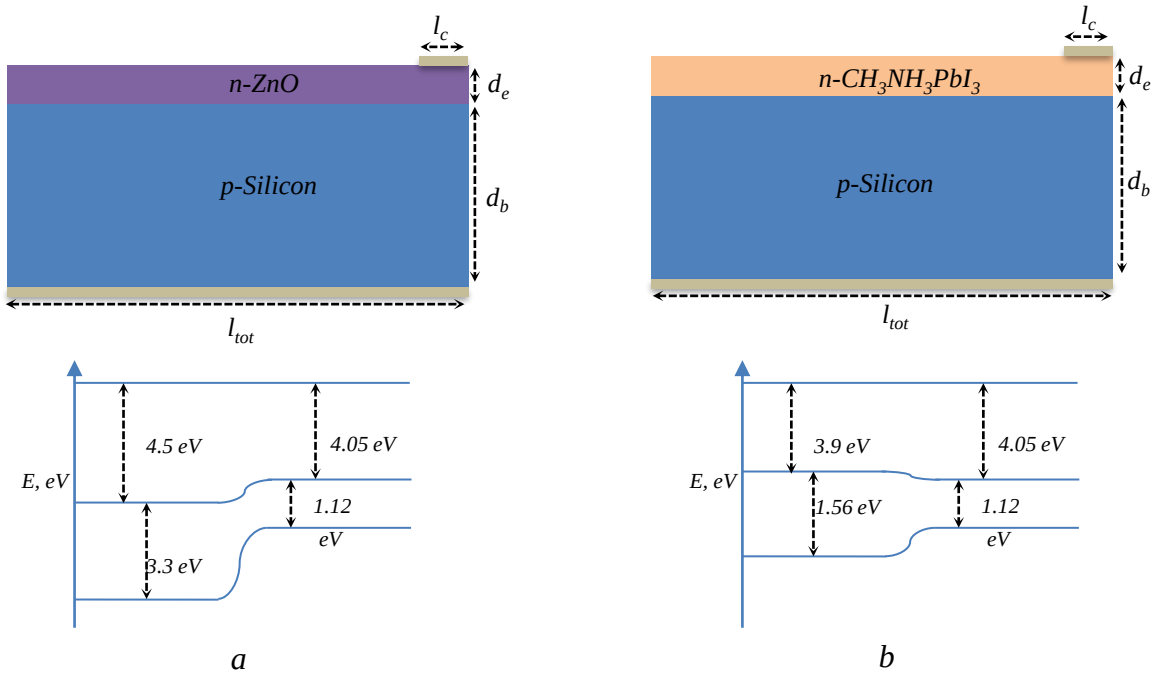
TRADITIONAL SILICON SOLAR CELL MANUCATURING AND SOL GEL METHOD

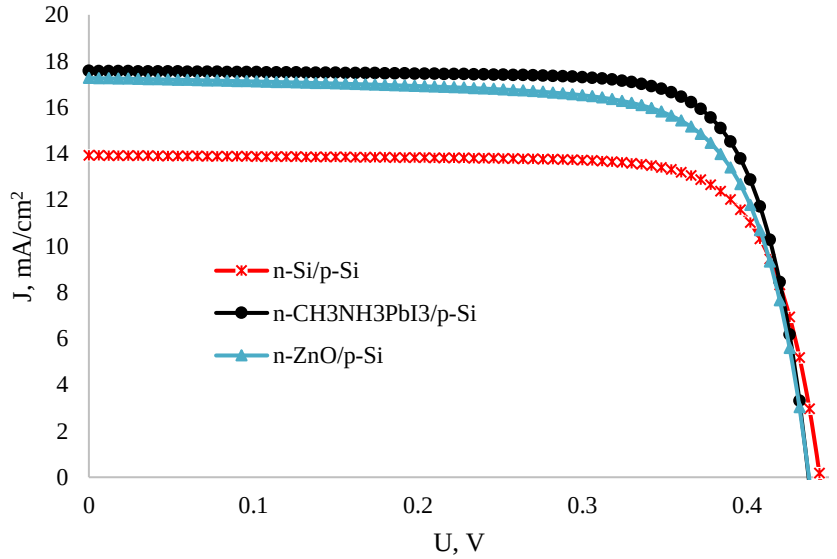




Merging of sol-gel method and silicon solar cell manufacturing process allow to create silicon heterojunction solar cells.

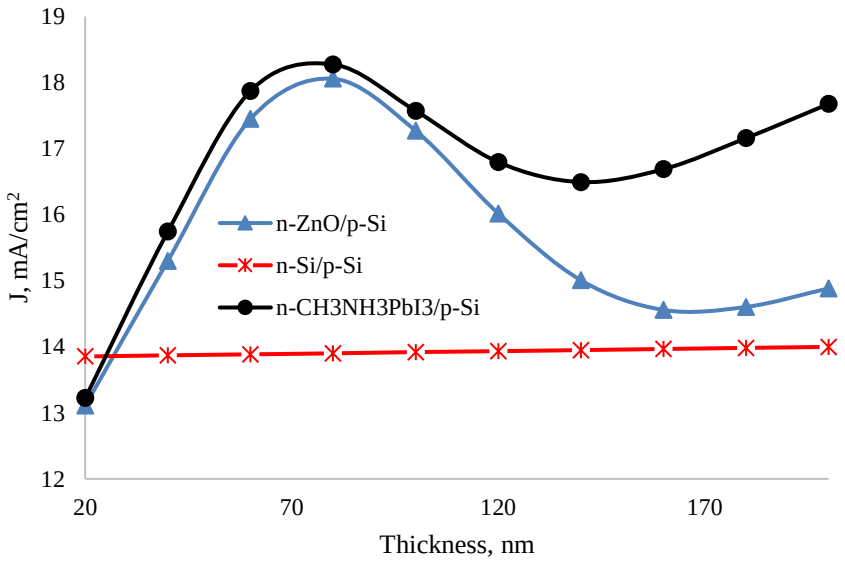
SILICON BASED HETEROJUNCTION SOLAR CELLS

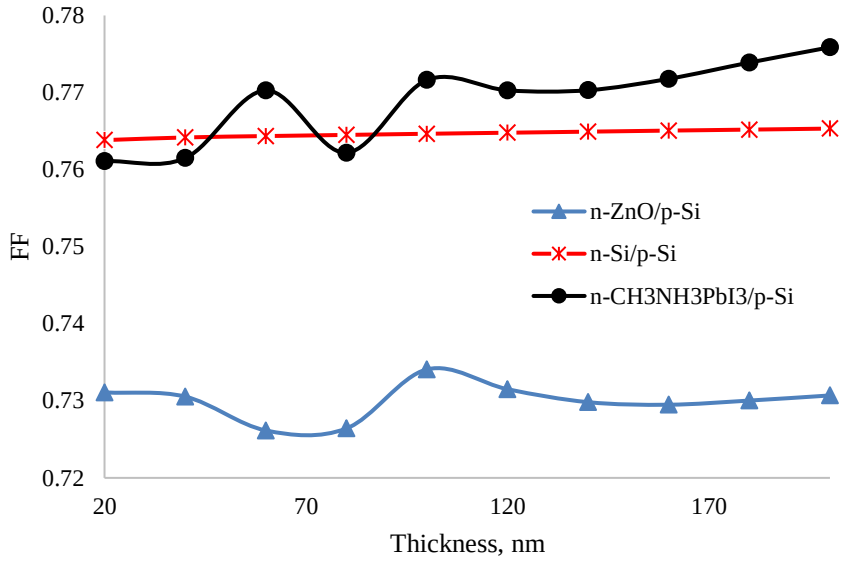




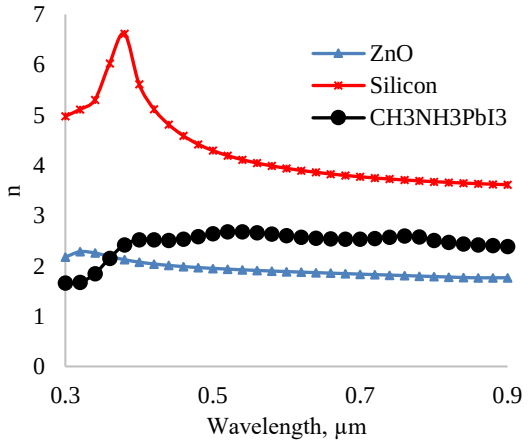
I-V characteristics of n-$CH_3NH_3PbI_3$/p-Si, n-ZnO/p-Si and n-Si/p-Si solar cells with emitter layer thickness of 100 nm

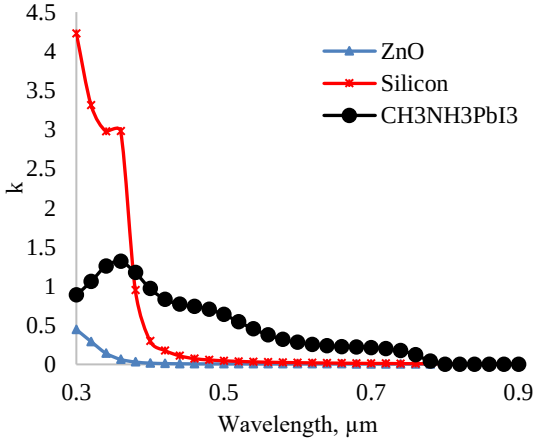
INFLUENCE OF EMITTER LAYER THICKNESS



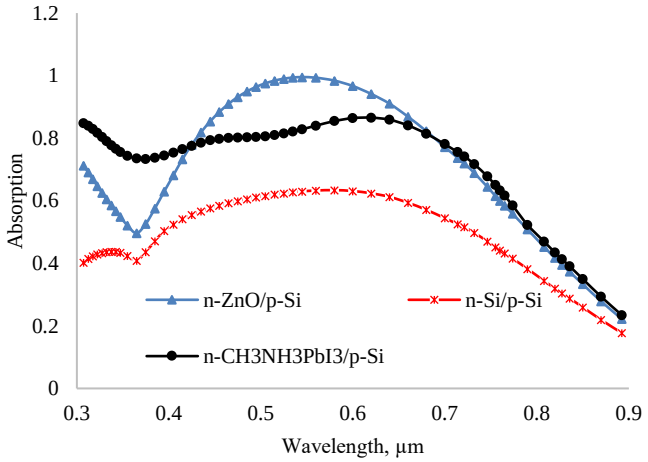


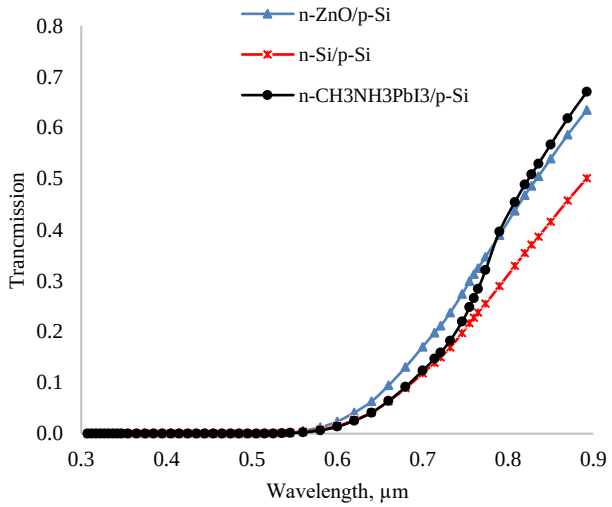
OPTICAL PROPERTIES

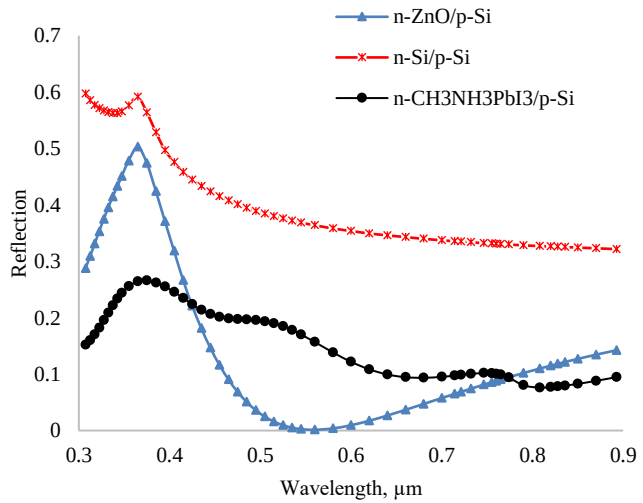




Complex refractive indices







Findings

CH3NH3PbI3 is good absorber layer and ZnO is optimal antireflection coating for silicon-based heterojunction solar cell.

The optimum emitter layer thickness for n-CH3NH3PbI3/p-Si and n-ZnO/p-Si solar cells was 80 nm

Thank you!