# Light Directional Elements

## fabricated by Nano Imprint Lithography

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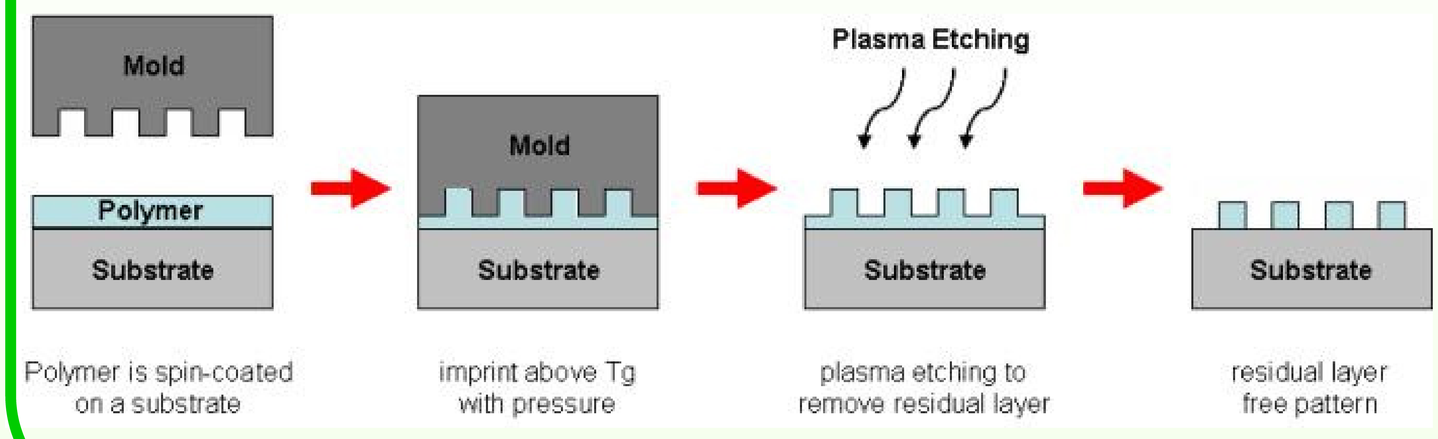
## Motivation

Why is Nano Imprint Lithography (NIL) a green technology?

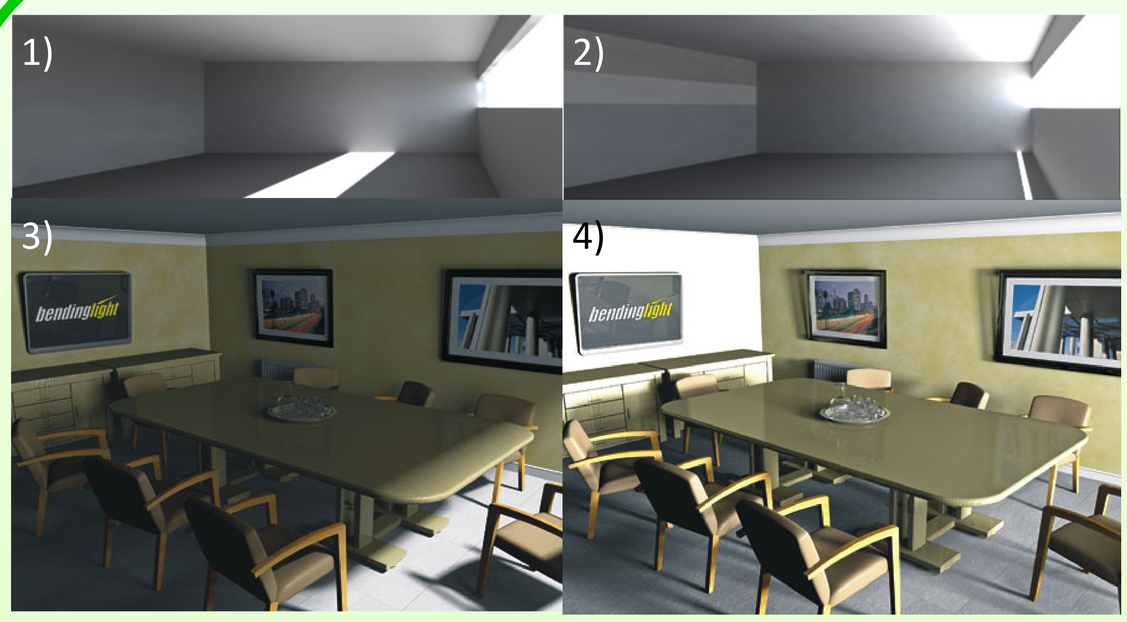
- NIL can be used to effectively save energy by creating nanostructures in windows to redirect the sunlight in offices and houses. This makes it possible to use the natural sunlight, rather than electric light, to illuminate the rooms.
- The efficiency of solar cells can be improved by creating nanostructures to increase the active surface area, and by creating reflective and anti-reflective layers.

## Nano Imprint Lithography (NIL)

NIL is a method to parallel process nanostructures.




## Light Directional Windows




Today extensive amounts of electricity is used for lighting. On average 10% of the electricity in private homes and 38% for commercial sectors are used for lighting. [1]

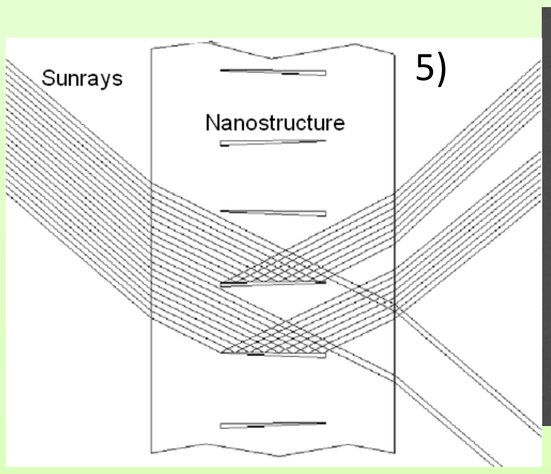
By creating nanostructures in a window it is possible to refract the light in different directions and control the path of the rays. This technique can prevent the use of blinds and electric light during a sunny day, as the sunrays does not overexpose a certain area while other areas remain dark.

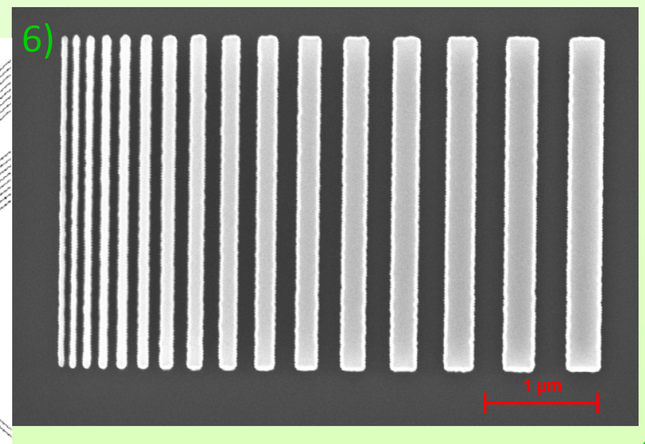
1) and 2) shows a simulation of a room with normal and nanostructured light directing windows. [2]

3) and 4) illustrates a room and the difference between normal and nanostructured light directing windows. [3]

5) shows how the nanostructures in the window changes the path of the sunrays. [4]

6) shows an example of a nanostructure which can be used to refract light.

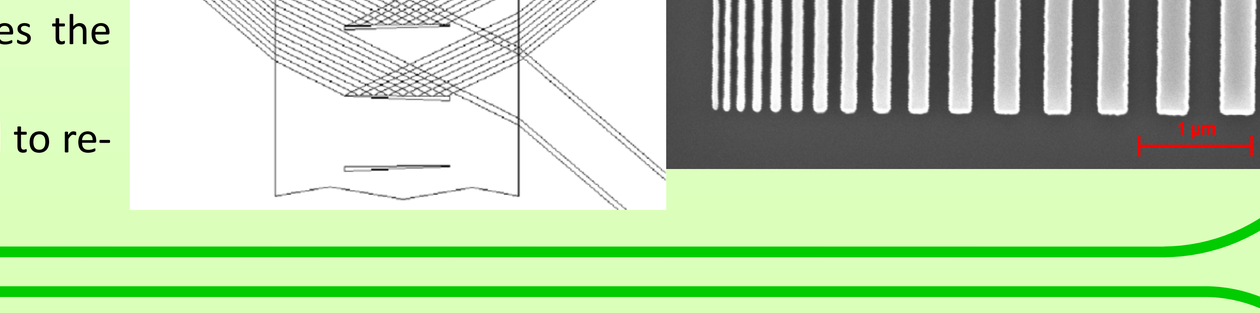



## Solar cells

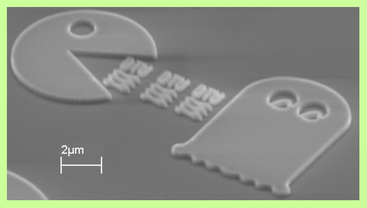
One the most efficient solar cells are the crystalline silicon solar cell which has an efficiency of about 20%. The manufacturing cost is high, but NIL technology enables a cost efficient approach to enhancing the efficiency by controlled surface structuring:

- A) Increasing light harvesting in the cell can be done by minimizing the reflection of sunlight by creating an anti-reflection surface using NIL. The nanostructures at the surface also enables rays at a larger incident angles to be utilized.
- B) Periodic patterning of the pn-junction can increase the power conversion efficiency from 20% to 30%. The electricity in a solar cell is generated at the interface between two different types of silicon called the pn-junction. The patterning increases the active interface area.
- C) Minimizing the amount of escaping light, and increasing the internal refection in the cell. This can be done by using a reflecting nanostructured back side. [5]




Nanostructured top contact | nanostructured junction | nanostructured backreflector

References:
[1] Secondary energy infobook, National Energy Education Development (NEED) project. http://www.need.org
[2] Design and Evaluation of Daylighting Applications of Holographic Glazings, K. Papamichael, C. Ehrlech, G. Ward
[3] http://www.bendinglight.co.uk/serraglaze.asp
[4] SERRAGLAZE - How Serraglaze works. http://www.bendinglight.co.uk/assets/pdf_downloads/How_Serraglaze_Works.pdf
[5] Nano Imprint Lithography for Photovoltaic Solar Cells, Increased efficiency through surface structuring. Obducat Technologies AB

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