GRØN DYST Abstract: Black Silicon Solar Cells

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A renewable energy source basically needs to fulfill two demands: It needs to be found in abundant amounts and we need to be able to convert its energy to our desired type of energy, typically electrical.
Solar energy definitely fulfills the demand of abundance. The Earth receives $1.7 \cdot 10^5$ TW[i] from the Sun, while the Earth has a total consumption of only 15 TW[ii]. Thus the Sun is able to provide all the energy we need, if only we are able to collect this energy, which irradiates our planet constantly. A solar cell is the device that fulfills the demand of us being able to convert the solar energy to electrical power. Therefore the optimization of solar cells, making them a cost-efficient alternative energy source, is a very important research topic.
As part of this research topic, this project aims to optimize the solar cell by applying a new kind of material in order to optimize the absorption of the solar radiation. By changing the surface of the conventional solar cell absorption-material, silicon, on nanoscale, the absorption can possibly and hopefully be improved. If this is the case the next challenge in this project is to incorporate the material in a functioning solar cell, which can actually transform sunlight into electrical power.
The purpose of this project is to make a solar cell of **black silicon** (BS), or rather to investigate if BS can be used as a photovoltaic and if it can, how efficient it is compared to a conventional solar cell.
BS is silicon, which has been structured on the surface on nanoscale. The created nanopeaks make the silicon black.
When creating the peaks on the Si-wafer the surface area is radically increased. It is assumed that this will increase the absorption of sunlight. Thus we have reasons to believe that BS-structures have the potential to become competitive, efficient photovoltaics. The intention is to investigate this following these main steps in the disposition:

- Fabricating the most optimal kind of nanostructures on a Si surface
- Making a pn-junction in the BS-structure and adding metallic contacts such that the BS-wafer can in practice be used as a solar cell.
- Measuring the IV-characteristics and the power conversion efficiency of the BS-solar cell to compare with the known results for the conventional solar cells and other BS solar cells.

The fabrication technique of nanostructures applied in this project has advantages compared with competitors. The technique is a maskless etching, which makes the fabrication relatively simple, and potentially easy to mass produce.

To summarize; the motivation in this project is to find out if BS is suitable as the absorbing material in solar cells and if it is, to optimize and actually produce a BS-solar cell. An important point is that this project has a **"proof of concept" approach**, meaning that the primary priority is to test, whether BS is suitable for solar cells rather than optimizing the actual efficiency of the produced solar cell.

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[i] Tester, Jefferson W.; et al. (2005). *Sustainable Energy: Choosing Among Options*. The MIT Press. ISBN 0-262-20153-4.
[ii] "Energy - Consumption'!A1 Consumption by fuel, 1965 - 2008". Statistical Review of World Energy 2009, BP. July 31 2006.