Laser Doped Nanostructured Solar Cells

J. N. Hansen and P. L. Moritzen

DTU Nanotech, Technical University of Denmark

INTRODUCTION

The global energy consumption demands increasingly effective energy sources available at low cost. The full potential of solar energy is far from reached, and by a novel type of solar cell a high efficiency cell can be obtained whilst reducing production costs compared to present technologies. Our solution is in the combination of three high tech features: Black Silicon, ALD passivation and laser doping. These technologies can eliminate cumbersome production steps used for conventional solar cells and are industrially scalable.

A NOVEL TYPE OF SOLAR CELL

A crucial factor for the efficiency of the solar cell is to absorb as much light as possible. By having a front surface textured with “black silicon” nanostructures the reflectance can be as low as 0.1% compared to 6% in a typical commercially available cell. When light is absorbed in the solar cell, electrons are mobilized thus carrying a current. To isolate the electrons from the outer environment, the surface of the cell must be passivated. The technique known as ALD (Atomic Layer Deposition) makes it possible to cover the black silicon surface uniformly with a layer thickness on the nanometer scale. The dielectric material Al_2O_3 is used for passivation and at the same time it acts as the dopant source for the following laser doping process. For a high efficiency cell a selective emitter is desirable. This is a highly doped region right beneath the metal contacts on the front side which leads to a better conductivity of current. This can be done very efficiently by combination of laser doping and electroplating. The central concept of laser doping is rapidly melting the top layer of a silicon substrate whereon the dopant is present. Laser doping is precise, allows self-aligned metal contacts and has a lower thermal budget than conventional methods. By applying these key concepts to production of the cell a more efficient and less costly product can easily be realized.

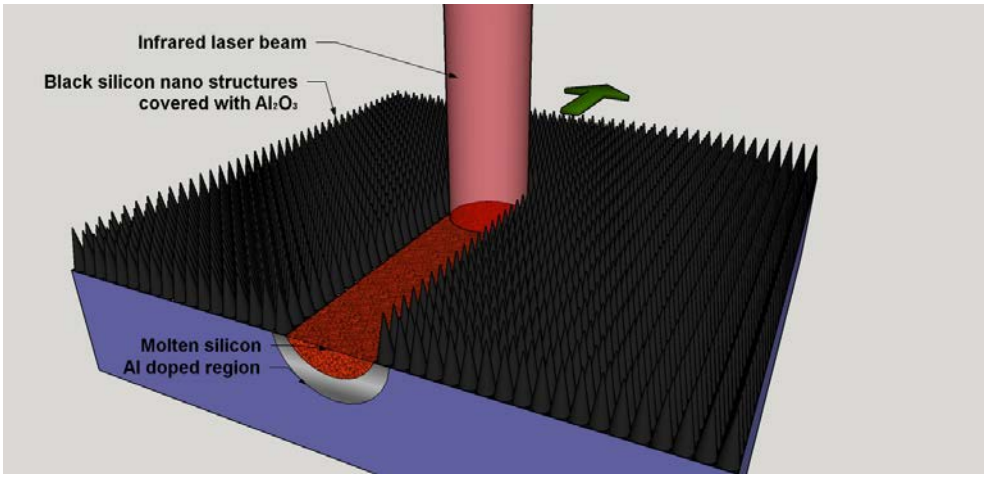

Figure 1: Laser doping of nanostructured silicon enhances efficiency and lowers production cost of the solar cell