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New strategy for local diffusion of dopants in crystalline silicon

A new methodology to replace conventional diffusion processes has been developed and patented. This simple procedure offers a wide versatility, since it allows the creation of locally doped regions without photolithography steps while simultaneously reducing the global thermal budget of the emitter creation process. The potential of the method has been already confirmed for silicon solar cell applications. Partners to further develop the technology and/or to establish commercial agreements along with technical cooperation are sought.

The Challenge

Photovoltaic technology is playing an increasing role in the current electricity generation market. Nevertheless, technological improvements are still required to increase its competitiveness when compared with other green technologies. Consequently, lower manufacturing costs and increased conversion efficiencies are needed. In order to reduce costs, thinner wafers are being increasingly used in crystalline silicon (c-Si) technology. Furthermore, an increased use of selective emitters, capable of increasing conversion efficiencies, has been also recently observed.

The standard process for emitter formation in c-Si solar cells does typically involve the diffusion of dopants, which traditionally involves thermal steps where the entire wafers are subjected to temperatures as high as 800 °C. This kind of annealing treatment can be inconvenient when using very thin silicon substrates due to the undesirable warping effects. Besides, and even more importantly, traditional furnace diffusion is not selective, so selective emitters cannot be easily manufactured. Thus, doping occurs across the entire substrate surface and on both sides. Additional and expensive steps, such as oxidation and photolithography are required in order to obtain selective emitters by traditional furnace diffusion.

The Technology

The proposed methodology provides a simplified process to locally dope in those regions where a specific doping profile is required. This technology is based on a laser direct-writing process. Dopants are placed onto a support, which is transparent to the laser radiation, and a laser beam is focused at selected spots, so that transfer of the dopant species towards the silicon substrate is achieved. Besides, laser radiation results in the local heating of the substrate, thus leading to a selective diffusion into the silicon wafer.

Innovative advantages

- Selective emitters without photolithography or oxidation steps
- Local doping and removal of silicon coatings (passivation and/or antireflection coatings)
- Reduce the global thermal budget of silicon solar cell fabrication
- Easy integration into silicon solar cells production lines

Current stage of development

Diode behavior of the doped regions created on N-type crystalline silicon has already been verified in the laboratory. There is still a need for a validation of the process at industrial scale and the performance of photovoltaic devices manufactured according to the method needs to be compared with that of standard solar cells.

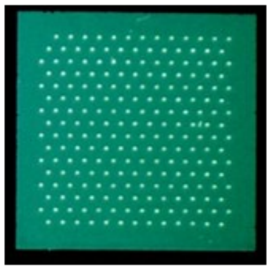
Applications and Target Market

Industries working on crystalline silicon photovoltaics, either as a solar cell manufacturer or as an equipment supplier. In particular, companies with a focus on the fabrication of high efficiency solar cells based on selective emitter technology.

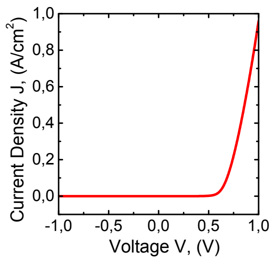
Reference number

MKT2012/0137_I

New Strategy to doped N-type crystalline silicon



Little p+ doped regions forming an array



Diode behaviour obtained from the local doping following this new method

Business Opportunity
Technology available for licensing with technical cooperation

Patent Status
Priority application

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