New technique enables much faster production of inexpensive solar cells

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Delft University of Technology in the Netherlands has demonstrated that the speed at which inexpensive solar cells are produced can be increased by a factor of ten – and that this can be achieved without any detriment to the energy yield of the cells. This will almost certainly result in a further reduction in the price of the cells, which are made of amorphous silicon.

On Monday 14 March, Michael Wank defended his thesis on this subject at TU Delft.

The production of electricity from solar cells is potentially a very attractive and sustainable technology. However, the problem is that the cost of electricity generated using solar cells is still considerably greater than is the case for conventional fossil sources. The higher cost is partly owing to the characteristics of the most widely used material in solar cells: crystalline silicon.

'An interesting alternative to crystalline silicon is amorphous silicon,' says Professor Miro Zeman of TU Delft, Michael Wank's PhD supervisor. 'Although this material has a lower energy yield than crystalline silicon, these solar cells can be produced far more cheaply. The nature of the material means that much thinner layers can be used - around 250 nanometres thick, compared with the 200-micrometre thickness in the case of crystalline silicon.'

Amorphous silicon solar cells are already being produced for this reason.

'One significant problem for the industry, however, is that the usual production technique (vaporising layers of silane gas) is too slow. It takes about one second to apply a 0.1-nanometre layer, so to apply a complete 250-nanometre layer requires about 40 minutes,' explains Professor Zeman. 'That is really too long, and is reflected in too high a cost-price.'

It was for this reason that PhD student Michael Wank concentrated on the new ETP-CVD (expanding thermal plasma chemical vapour deposition) production technique, with which he achieved remarkable success. The production technique was developed by Eindhoven University of Technology; Michael Wank's project, which was subsided by Agentschap NL, was carried out in collaboration with the Plasma and Material Processing group of Professor Richard van de Sanden. The speed of production was eventually increased by a factor of ten, to one nanometre per second, while maintaining a good energy yield (for amorphous silicon) of around 7 per cent.

There was one remaining obstacle Wank had to overcome, though – the fact that the ETP-CVD technique requires a temperature of around 350 degree Celsius in order to make amorphous silicon of the required quality. However, a production temperature of that level causes damage to the solar cells, which affects their energy yield.

In order to circumvent this, Wank applied an ion bombardment (charged particles) during the production process. The ions provide the developing surface with sufficient energy, so that production can take place at a much lower and therefore non-harmful temperature of around 200 degrees Celsius.

'The results of the research are of great interest to industry, which can use the method to make solar cells quickly and inexpensively,' says Professor Zeman. 'As well as the greater speed, another benefit is that

the machines needed for this technology are smaller. All in all, this technique promises to cut the production costs of this type of solar cell considerably.'

Provided by Delft University of Technology