Project HAVEMOR: High added project modules for BIPV

Background

Energy use in buildings comprises around 40% of UK consumption and is a major contributor to green house gas emissions in the UK. Building Integrated Photovoltaics (BIPV) into buildings is therefore a huge commercial opportunity in the UK and globally. To date the products available to architects have been standard modules used in roof top and large solar arrays. Research has shown that architects require a range of photovoltaic modules with coloured solar cells of different shape and colour for improved aesthetics in and on buildings.

Objectives

Project Havemor is a joint R&D funded project led by Narec with PV Crystalox and Romag. The aim is to develop a range of photovoltaic modules with coloured solar cells of different shape and colour and demonstrate the potential of the approach by fabricating a number of prototype modules which illustrates the flexibility and visual attraction of shape and colour in BIPV, giving architects a free hand to design buildings which are both energy efficient and visually attractive.

Process

A survey was initially conducted amongst 100 UK architects to ascertain their views and requirements around using coloured solar cells of various shapes to develop the BIPV market.

Solar cell processing

The reflectivity for different wavelengths and the colour of the film changes as the thickness of the silicon nitride coating is varied. Increasing the thickness of this film results in the colour of the cell changing from lighter blue to silver then gold, magenta to finally green.

The silicon nitride was deposited in a low pressure chemical vapour deposition (LPCVD) reactor. The temperature profile, gas flows and pressures were varied in the reactor to achieve good uniformity across each wafer and from wafer to wafer.

The final step was to scribe a deep line around the cell rear to enable a narrow sliver of silicon to be cleaved away to give good electrical isolation of the p-n junction in the solar cell. The laser was successfully modified to allow a variety of curved shapes as well as straight sided objects in regular and asymmetric shapes to be obtained.

As the antireflection coating (ARC) thickness for colour is non optimum for solar cell efficiency the solar cell process was fine tuned to boost the solar cell efficiency for coloured cells.

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Prototype Fabrication

A standard production line at Romag was used to produce the prototypes.

Three prototype modules were produced:
1. Wave module
2. Romag logo module (rectangular cells)
3. Crystalox logo

The results of the project were disseminated throughout the project duration, papers were presented at national and international PV conferences.

Results

Module type	Power (Wp)	Efficiency (%)
Standard	190	15.1
Wave	107	10.8
Romag Black	95.2	11.4
Romag Magenta	38.8	10.8

Table 1: Module powers and efficiencies of prototypes.

The results for the power output of the three prototype modules are shown in Table 1.

The range of efficiencies is higher than that which would be obtained using state of the art thin film modules and is comparable with module efficiencies obtained using standard screen printed silicon solar cells. This indicates that the use of colour does not significantly reduce the power that might be expected for a given building façade area. The cost analysis also highlighted that in relation to the cost per unit area of panels the cost of the coloured module is only 5% higher than that for standard modules.

The project helped to demonstrate that these various cells could be combined into highly attractive patterns and the complex alignments of cells could be maintained through the lamination process.

Project outcome

The project has demonstrated that there is strong interest in integrating photovoltaic modules into buildings (BIPV) whilst being energy efficient and visually attractive, a complete manufacturing process is also feasible. Narec is currently looking to expand its production capacity to large scale low cost solar cell manufacturing.

Dr. Tim Bruton, Consultant, Narec, said: “We anticipate that the BIPV market worldwide will grow rapidly as the cost savings of using PV modules as an outer element of a building are established. As specialists in the UK for multicrystalline silicon wafer development, now is the time for us to exploit this opportunity, and by increasing choice we will stimulate demand. We are aiming to give the building industry the tools it needs to make integrated renewable technologies a viable and cost-effective option for new developments.”

Project duration

01/11/2006 - 28/02/2009

Project cost

Total cost - £374314
Technology Strategy Board Low Carbon Energy Technologies programme contributed - £153159

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