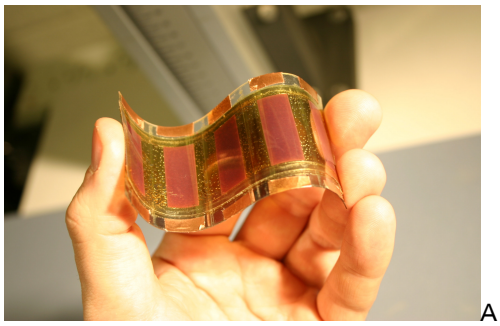
dti

PROJECT PROFILE NO PP241

Power On Plastic

OBJECTIVES

- To demonstrate the technical feasibility of manufacturing a dye-sensitised solar cell (DSC) on a flexible substrate, using processes compatible with volume production.
- A performance target is to achieve bench-scale single cell efficiencies of 5% at illumination levels approaching 1 Sun (AM1.5) with short term durability.
- The durability of dye-sensitised solar cells is a recognised issue and needs to be compatible with end use. Cell lifetime will be one of the principal issues addressed in this project.
- To make a prototype module of solar cells using pilot scale manufacturing processes that has an efficiency of at least 4% at illumination levels approaching 0.5 Sun (AM1.5).
- To develop the diagnostic (i.e. illumination, measurement, analytical and accelerated keeping) capabilities to meet these challenges.



A five-cell array of DSCs fabricated on a flexible PET substrate.

SUMMARY

Dye-sensitised solar cells were first demonstrated in public in the early 90s and their potential for enabling cheap photovoltaics (PV) by virtue of low materials and processing costs was immediately recognised.

The energy conversion efficiency of DSC cells made on glass substrates with liquid electrolytes has steadily increased and surpassed 10% (AM1.5, 1 Sun conditions). However, the last five years or so have seen a marked trend toward developing DSC cells with solid electrolytes on plastic substrates (PDSCs).

A lot of academic interest has ensued, with claims of 5% performance with PDSCs, but to our knowledge no one has yet moved to the manufacturing stage with these systems. This is in part due to the difficulties of

scaling-up this technology whilst maintaining efficiency.

The flexible format is seen as offering advantages over glass in volume manufacture and in end-use versatility.

Flexible PV using a-Si on plastic substrates have begun to appear in the market. Despite conversion efficiency only around 5%, these systems have been successful in selling into niche markets.

Thus it is possible to get market experience with PDSC technology at the current level of performance provided that the efficiency can be maintained at higher illumination levels and the operational lifetime is acceptable in the marketplace. PDSC performance, at present, tends to tail away under higher illumination conditions.

The rapidly increasing need for power on plastic substrates for new low-power markets such as wireless electronics and portable personal electronics will further enhance the opportunities for companies entering the flexible PV market.

It is believed that the performance of PDSCs can be further improved so that with their low cost and robustness, they compete successfully with a-Si systems in more traditional markets.

Experience gained in the low-power market will greatly facilitate development in the longer term of more advanced PDSC products for low-to-medium and portable power applications where system integration and installation savings will become increasingly important.

This work builds on a previous LINK project involving JM, Imperial College, London and Cambridge University.

CONTRACTOR

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COST

The total cost of this project is £954,000 with the Department of Trade and Industry (DTI) contributing £477,000 and Kodak and JMTC the balance.

DURATION

27 months – February 2005 to May 2007.