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Flexible, Transparent PV Laminate

The Problem

Solar technology is making huge advances in terms of efficiencies achieved in cells. Although this is happening at a laboratory scale, transferring this to a product that is cheap and quick to make using safe, abundant materials is not always possible.

Research was focused on solving the problem of adhering top conducting material to the solar cell. At present, this is done using gold which is not only expensive but involves time consuming procedures such as a vacuum process in order to manufacture.

Using gold increases the production time and cost of the cells, which in turn makes the solar cells expensive to purchase. For these efficiencies to be passed on to marketable solar cells, we need to find a way of creating a product that can be mass produced cheaply and quickly.

Researcher Daniel Bryant came up with a new design for solar cells that reduced manufacturing costs and production time using earth abundant materials and a novel laminate he developed.

The conductive layer of gold that is expensive and difficult to apply was replaced with a nickel grid that is stuck down using a new material based on common tile adhesive.

The Challenges

We sourced a transparent conducting sheet embedded with a nickel microgrid that was capable of current collection over a large area (Epimesh, Epigem). We also needed a way to apply this to the cells that conducted from the cell to the grid, would provide a mechanical bond to maintain electrical contact but that didn't compromise on transparency.

At the time of development there was no material that provided all these functions - so we developed one.

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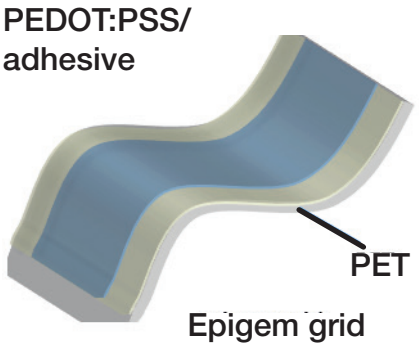
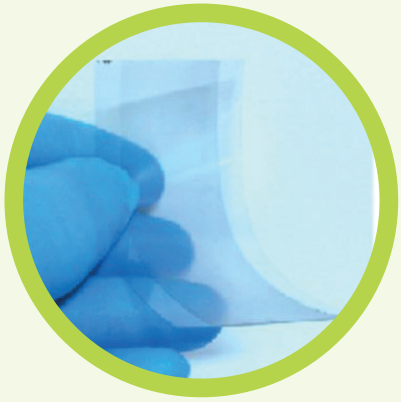
Taking inspiration from the tapes and adhesives industry we used an acrylic microemulsion, knowing that these types of materials would be well suited to the requirements and also lend themselves well to reformulation. After some development using different conductors PEDOT:PSS worked in the adhesive to provide the conduction. The adhesive is both conductive and transparent, which means that the solar cells can be applied to glass as well as metal.



The Impact



The new design represents a major breakthrough in this technology and the route to scale up of this technology can now be clearly defined. The critical advantage of the new room temperature lamination method is that it is well suited to mass production using well established processes.

Currently the performance of devices made with the laminate are comparable to ones made with gold electrodes, indeed there is only minimal losses observed.

It is hoped that any future efficiency rises of third generation cells made with metallic contacts can be at least matched using a laminate type design. In addition to this it opens up the possibility for new device architectures and designs to be realised.

So far this method has been shown to have the capability to fabricate fully printed, atmospherically produced, gold free solar cells with comparable performance to the standard method.

The research was undertaken by Dan Bryant and the SPECIFIC PV team in partnership with Professor Henry Snaith and his team at Oxford University using nickel mesh made by Epigem.

The research was published in Advanced Materials.

Swansea University Prifysgol Abertawe

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