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A CASE STUDY ON THE MECHANICAL INTEGRITY OF PRINTED SOLAR FILMS

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The features of Organic Photovoltaic (OPV) based printed solar films (PSF) make it ideal to be integrated into a range of consumer products. In this context, flexible solar modules are likely to be handled by end-users during the course of real-life applications and thus can be subject to various mechanical deformations such as bending, twisting, shearing, sliding, stretching and rolling. All these stress conditions can potentially impact the mechanical stability of the printed solar modules. The degradation of various types of printed solar film has been well studied under both controlled and outdoor environmental conditions previously [1] [2]. However, understanding the effect of real user handling in the field is an important area to address and will have a significant impact in expediating the commercialisation of this technology. This poster presentation focuses on a case study to investigate the dependency of the stability of printed solar modules mainly due to mechanical deformations induced by handling by end-users over a 12-month period.

This Australian Centre for Advanced Photovoltaics (ACAP) funded research study is also a STEM education and outreach initiative. The Science Technology Education Leveraging Relevance (STELR) project is the National STEM (science, technology, engineering, and mathematics) schools initiative of the Australian Academy of Technology and Engineering (ASTE). STELR is deployed in over 600 schools around Australia and overseas. Flexible OPV modules will complement the renewable energy program offered by STELR where students will play the role of end-users, undertaking guided and open-ended research into solar electricity generation. Over 100 schools in Australia, New Zealand, the Philippines and Indonesia are taking part in the program and up to 25,000 students are expected to be involved.

Over 500 printed and encapsulated OPV modules with various photoactive ink materials and encapsulation architectures have been fabricated using the roll-to-roll printing and encapsulating facilities at CSIRO in Clayton. For detailed evaluation of the OPV modules, suitable analysis methods such as current-voltage characterisation, photocurrent maps and electroluminescence images have been utilised. Initially, the modules have been characterised using these techniques prior to sending them to the end-users who will be handling them for over one year under different geographical locations and environmental conditions. A characterisation kit has been designed, mass produced and deployed to the schools along with over 500 OPV modules. Groups of students will use a range of methods, including characterisation kits and monitoring under different conditions, to assess these OPV modules.

This poster will highlight preliminary results obtained based on the initial characterisation of over 500 fully-printed modules encapsulated using two different encapsulation architectures (partial or complete) and having P3HT:PCBM or Pi-4 (commercial active layer ink from infinityPV) as the photoactive layers and, polyethylenimine ethoxylated (PEIE) or ZnO as the electron selective layer.

References

[1] Weerasinghe, H. C., Rolston, N.,Vak D., Scully, A. D.,Dauskardt, R. H., **'A stability study of roll-to-roll processed organic photovoltaic modules containing a polymeric electron-selective layer'** Solar Energy Materials and Solar Cells, Aug 2016.

[2] Weerasinghe, H. C.,Robotham, B.,Fell, C. J.,Jones D.,Scully, A. D., **'New Barrier Encapsulation and Lifetime Assessment of Printed Organic Photovoltaic Modules'** Solar Energy Materials and Solar Cells, Oct 2016.