South African Institute of Electrical Engineers

KZN SAIEE

April 2014

recharge

Official Newsletter of the **KwaZulu-Natal** Centre

KZN SAIEE – reaching out to its Members

SAIEE PRESIDENT, Dr PAT NAIDOO'S INAUGURAL ADDRESS
Photo taken at the April, SAIEE KZN Centre presentation in Pietermaritzburg: at left is Veer Ramnarain (SAIEE KZN Centre Chairman) with Dr Pat Naidoo and his wife Maureen.

JANUARY PRESENTATION: Subhash Jagannath gave an Introduction to Fibre Optic Communication systems at the SAIEE KZN Centre January presentation. Here he is seen shaking hands with Chris Ramble (KZN Centre Committee Member).

(Right) Fibre Optic Communication Components on display at the presentation.

FEBRUARY PRESENTATION:
Paper presented by R Lange

PV module production process and raw materials

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A SCHEMATIC PRESENTATION of a crystalline silicon based PV module is given in Figure 1. The fragile PV cells are connected in series by soldering using copper-based ribbons and subsequently embedded in a rubber-like encapsulant (***see Figure 1 at bottom of next page***). This encapsulant, mostly a co-polymer of ethylene and vinyl acetate (EVA), acts both as a "glue" to hold the complete module together as well as a decoupling agent for the mechanical forces applied to the module in its lifetime to prevent the growth of micro-cracks and hence cell breakage. The front glass, in general with a thickness of 3.2mm and tempered, is a highly transparent glass with a minimum amount of ferric iron ($Fe3+$ causes the greenish shine of non-solar glass). The glass is an important component due to its longevity as well as the mechanical stiffness. The back sheet is based on a poly(ethylene terephthalate) or PET core layer. This PET layer is used as the electrical insulation against the generated system voltage of 1000V (DC, Voc at STC). The junction-box acts as the power plug and includes the diodes, needed to manage potential (partly) shading issues, as well as the connector plugs that are important to minimise power losses. Finally, the aluminium frame contributes to the PV module's stiffness and eases the mounting.

The PV module manufacturing process is schematically depicted in figure 2 and consists of the 3 main processing steps of the electrical cell connection, the encapsulation and the sun simulation. The electrical cell connection is performed by a so-called tabbing and stringing process and determines

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SAIEE 2014 Programme (January to April)
KZN CENTRE

The 2014 SAIEE KZN Centre events held to date have all been well attended and well received

Date	Presentation / Tutorial / Visit
January	
23/01/14	**Presentation:** Introduction to Fibre Optic Communication Systems by Subhash Jagannath
February	
4 & 5/02/14	**CPD Course:** Mastering Power System Fault Calculations by Professor Piet Swart
26/02/14	**Presentation:** The Manufacturing, Installation and Quality of Solar PV Panels – The Direct Conversion of Light into Electricity by Dr Ronald FM Lange
March	
19/03/14	**Presentation/Visit:** Ls Resin Cast Transformers and Ls Motor Control by Gary Paterson
April	
15/04/14	**Repeat of 2014 SAIEE President's Inaugural Address (PMB):** Engineering Electrical Engineers For a World Class South Africa by Pathmanathan (Pat) Naidoo
16/04/14	**AGM** & **Repeat of 2014 SAIEE President's Inaugural Address (DBN):** Engineering Electrical Engineers For a World Class South Africa by Pathmanathan (Pat) Naidoo

SAIEE 2014 Proposed Programme
KZN CENTRE (May to November)

Each of the SAIEE KZN Centre events will be confirmed by the distribution of a notice calling for RSVPs

Date	Presentation / Tutorial / Visit
May	
15/05/14	**Collaboration Event:** 2 pm – 6 pm. Arranged by SAIEE, KSEF, IESSA, ICMEESA
21/05/14	**Presentation:** The Role of Engineering in Aviation and in Advancing Air Traffic Management (ATM) in the Africa Region by Thabani Mthiyane (ATNS)
June	
18/06/14	**Presentation:** VSDs: Out of the Box by Barrie Skinner (Illovo Sugar)
25/06/14	**½ day Course** Industrial Wireless Technology by Kevin Preston (Phoenix Contact)
July	
03/07/14	**Presentation/Visit:** Toyota Plant Visit
16/07/14	**Chairman's Breakfast Meeting:** Follow-up to 2013 Meeting
August	
20/08/14	**Presentation:** SANS 10142-2 (MV Wiring Code of Practice) by Antony Falconer (Abedare Cables)
date to be confirmed	**CPD Course**
September	
date to be confirmed	**2014 BP Lecture (DBN)**
date to be confirmed	**Repeat of 2014 BP Lecture (PMB)**
October	
15/10/14	**Presentation:** Distribution Automation by Shadil Singh – eThekwini Electricity
21 & 22/10/14	**CPD Course:** HTLS Conductors for Overhead Lines by Dr Brian Wareing (EA Technology)
November	
date to be confirmed	**KZN Centre Bi-Annual Dinner & Awards Evening**
19/11/14	**Presentation:** Innovations in Substation Design (3D designs and safety analysis) by a Presenter from Aurecon)

At the February presentation, Dr R Lange (third from left) posed with SAIEE KZN Centre Committee Members. His presentation was on "The Manufacturing, Installation and Quality of Solar PV Panels".

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the electrical output of the PV module. Here, a non-optimal soldering process increases the resistance of the connection and hence a decrease of the power output. The encapsulation or lamination process combines the different layers of the module and determines its quality and life time. An optimal lamination process results in well-defined interfaces between the different materials, increasing both the photon transport to the cell as well as the lifetime of the PV module (de-lamination). In both the tabbing/stringing as well as in the lamination process a careful management of the coefficient of thermal expansion (CTE) of the different materials is of utmost importance. A non-optimal soldering process will induce significant forces between the (inorganic silicon) cell and the (metal) ribbon during the daily day-night temperature differences that could lead to the growth of the existing micro-cracks, whereas a non-optimal cooling process in the lamination step induces a stress, mainly on the glass-encapsulant and encapsulant-backsheet interface, that eventually leads to de-lamination. The final sun simulation determines the power output and hence the economic value of the module. Here a solar spectrum match, the pulse (or flash) stability as well as the light uniformity are key to come to reliable values. An overrating of the PV module power output will result in a reputation and hence business loss for the PV module manufacturer whereas an underrating will decrease the margins.

The main quality tests performed in the PV module production line are next to the permanent visual checks the control of the electrical cell connection (dark current test), the electrical performance of the cell grid (EL testing), the lamination step (adhesion measurements and x-linking density if using EVA), the junction box and frame mounting (wet leakage and ground continuity) and finally an EL and HiPot test to exclude post-lamination processing defects and to guarantee an electrically safe product, respectively. *(See Figure 2)*

In summary, the PV module production process is thoroughly known and high quality PV modules can be produced locally in a certified production environment. A module assembly or laminate-to-module-conversion (lmc) intrinsically increases the cost price of a PV module without adding value. Hence, a module manufacturing or cell-to-module-conversion (cmc) process is favoured.

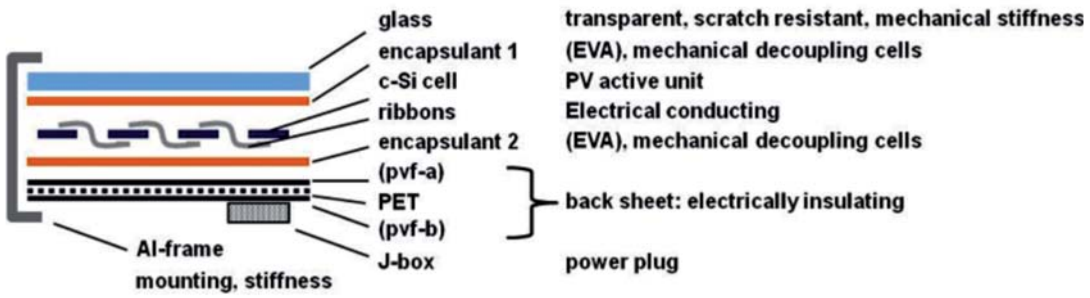

Figure 1 schematic presentation of a PV module depicting the various materials and their functions

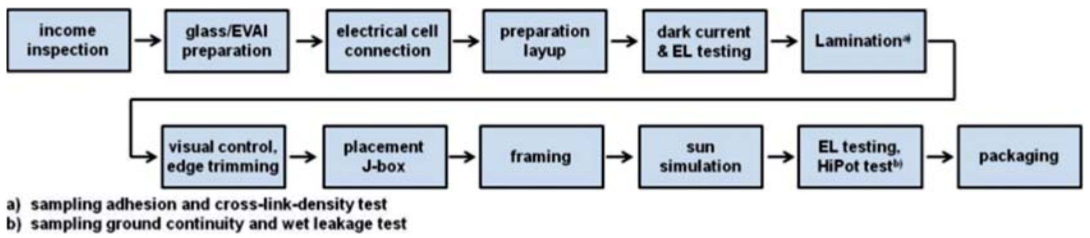

Figure 2 schematic representation of the main manufacturing and quality steps in the production of a PV module in a cell-to-module-conversion or cmc process (layup is defined as glass-EVAI-connected cell grid-EVAII-back sheet, where EVAI and EVAII are the top and bottom layer of the encapsulant EVA)

COLLABORATIVE EVENT:

Unite Building, Howard College Campus, UKZN

RSVP TO saiee@iafrica.com by 5 May, 2014

Thursday 15th May, 2014, 2 pm to 6 pm

Forum Meeting: Energy Management Systems

The SA Institute for Electrical Engineers (SAIEE) in KZN, the Illumination Engineering Society of South Africa (IESSA), the Institute for Certified Mechanical and Electrical Engineers SA (ICMEESA), the South African Association for Energy Efficiency (SAEE), eThekwini Municipality and KSEF invite you to attend this combined Forum Meeting on Energy Management Systems.

15 May 2014 Unite Building, Howard College Campus, UKZN	Start time	duration
Registration and tea/coffee	14:00 PM	00:30:00
Welcome & Introduction	14:30 PM	00:05:00
Presentations 1. Introduction to Energy Management Systems and Lessons and Experience from UKZN Campus *by Greg Diana, UKZN Energy Management Team*	14:35 PM	00:25:00
2. eThewkini Energy Management System Requirements *by Derek Morgan, eThekwini Energy Office*	15:00 PM	00:25:00
3. Integrated demand management achievements over the past 10 years *by Colin Openshaw, Eskom Regional IDM*	15:25 PM	00:40:00
Stretch break	16:05	00:15:00
4. Industrial Energy Management Systems: Synopsis, Trends and Examples *by Dave Mercer, Golder Associates Africa*	16:25 PM	00:40:00
5. Criteria for and Certification of Energy Efficiency Projects for 12L tax incentives *by Karel Steyn, Eskom and representing SA Association for Energy Efficiency*	17:05 PM	00:40:00
Discussion, Acknowledgments and Closure	17:45 PM	00:15:00
Refreshments, snacks and networking	18:00 PM	00:30:00

South African owned PV solar manufacturer

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