

## PRESS RELEASE

# Solliance sets world record for roll-to-roll produced perovskite-based solar cells with a stabilized efficiency of 12,6%

## Perovskite PV technology demonstrated on industrially-applicable roll-to-roll processes

**Eindhoven (the Netherlands), Leuven (Belgium), March 9, 2017 – Solliance announces the demonstration of an industrially-applicable roll-to-roll process for the production of solar cells, achieving a record 12,6% conversion efficiency on cell level. This breakthrough result paves the way towards an accelerated market introduction of this attractive new source of renewable energy.**

Perovskite microcrystals are a promising material to make high-yielding, thin-film solar cells. They can be processed into thin, light-weight and potentially semitransparent modules that could eventually be integrated in building materials such as windows or curved construction elements. Solliance and its research partners focus on using scalable, industrial processes towards the fabrication of large-area modules, eventually suitable for seamless integration in a broad variety of PV systems.

The roll-to-roll (R2R) process was developed for both the electron transport and the perovskite layers on the new Solliance dual R2R coating line, as developed by Solliance with its partners VDL Enabling Technologies Group (VDL ETG), Smit Thermal Solutions and Bosch-Rexroth. The in-line roll-to-roll coating, drying and annealing processes were executed at a linear speed of 5 m/min on a 30-cm wide commercial PET/ITO foil and under ambient conditions. After applying a newly developed off-line single device finishing step, individual solar cells of 0.1cm<sup>2</sup> achieved efficiencies of up to 12,6%, measured under maximum power point tracking conditions during 5 minutes. All process steps on this roll-to-roll line were performed using low cost materials whilst keeping the process temperatures below 120 °C. This shows the high volume production potential of this new emerging thin film PV technology.

“The demonstration of R2R processing at 5 m/min of perovskite layers for solar cells indicates that high-volume production, and hence with an expected very low cost, will be possible in the future”, explains Pim Groen, Professor of SMART materials at the Technical University of Delft and Program Manager at Holst Centre/Solliance. “These results show that the Solliance research partners, with their in depth know-how on processing of thin film PV devices and their extensive sheet-to-sheet and roll-to-roll pilot production infrastructure, are excellently placed to realize this upscaling.”

VDL ETG has been leading the consortium of equipment manufacturing companies that designed and built the innovative R2R coating line. VDL’s CEO Willem van der Leege comments: “I am very pleased with this result. It shows that combining process know-how at Solliance with capabilities of high-tech equipment companies in this region can deliver very powerful results that potentially open up completely new business opportunities.”

Richard Caldwell, Managing Director remarked: “Dyesol is very pleased with this breakthrough; we are committed to developing the industry standard for R2R Perovskite Solar Cell (PSC) PV manufacturing in conjunction with Solliance and this result is an important step along this route. This pioneering work confirms that Dyesol and its partners retain a global leadership position in the industrialisation of PSC Technology, and in particular, its continuous R2R processing for flexible BIPV applications – a core element of its commercialization strategy.”

The current world record efficiency of a small lab scale perovskite-based PV cell is 22,1%.

“The challenge is to upscale perovskite cells to larger size, industrially-manufacturable modules with high efficiency and long lifetime at low cost. These 12,6% R2R up-scaled perovskite-based solar cells are a first and important step in this development. With this result, we are confident to quickly boost the up-scaled perovskite based PV module efficiency above 15% by using low cost materials and processes. Furthermore, we are working hard to improve the stability of these devices under real life operational conditions”, explains Ronn Andriessen, Program Director at Solliance.

Thanks to its high power conversion efficiency and flexible and light-weight nature, thin-film perovskite PV technology is widely considered as a future key technology for the building-integrated photovoltaics (BIPV) market. It can be seamlessly integrated in building elements, on curved surfaces and can be made semitransparent. Combining the industrially-applicable manufacturing processes with Solliance’s proprietary back-end interconnection process allows the creation of perovskite-based PV modules with any form and shape and any desired current-voltage output. These properties will enable customized and aesthetic integration of solar modules for infrastructure, building and vehicle-integrated PV products.

Solliance is a cross-border Dutch-Flemish-German thin-film photovoltaics research initiative conducting advanced research on the development of perovskite-based PV modules and its applications with its industrial partners Solartek, Dyesol and Panasonic. With these results the Solliance partners demonstrate the effectiveness of their collaboration in the development of perovskite based PV modules.

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### **About Solliance**

*Solliance is a partnership of R&D organizations from the Netherlands, Belgium and Germany working in thin film photovoltaic solar energy (TFPV). In order to strengthen the region’s position as a world player in PV, Solliance is creating the required synergy by consolidating and coordinating the activities of 250 researchers in industry, at research institutes and universities.*

*Various state-of-the-art laboratories and pilot production lines are jointly used for dedicated research programs which are executed in close cooperation with the solar business community.*

*Solliance partners are: ECN, imec, TNO, Holst Centre, TU/e, Forschungszentrum Jülich, University Hasselt and Delft University of Technology.*

*Solliance offers participation in its research programs and opens up its lab facilities to new entrants, either from industry or in research. On the basis of clear Intellectual Property (IP)*

agreements, each industrial partner can participate in this research effort, or alternatively, hire equipment and experts to further develop its own technology.

### **About Holst Centre**

*Holst Centre is an independent R&D center that develops technologies for wireless autonomous sensor technologies and for flexible electronics, in an open innovation setting and in dedicated research trajectories. A key feature of Holst Centre is its partnership model with industry and academia based around shared roadmaps and programs. It is this kind of cross-fertilization that enables Holst Centre to tune its scientific strategy to industrial needs.*

*Holst Centre was set up in 2005 by imec (Flanders, Belgium) and TNO (The Netherlands) and is supported by local, regional and national governments. It is named after Gilles Holst, a Dutch pioneer in Research and Development and first director of Philips Research.*

*Located on High Tech Campus Eindhoven, Holst Centre benefits from, and contributes to, the state-of-the-art on-site facilities. Holst Centre has over 200 employees from some 28 nations and a commitment from over 40 industrial partners.*

### **About TNO**

*TNO is an independent Dutch Organization for applied scientific research, founded by law in 1932 to enable business and government to apply knowledge. TNO connects people and knowledge to create innovations that boost the competitive strength of industry and the well-being of society in a sustainable way. This is our mission and it is what drives us, the over 2,600 professionals at TNO, in our work every day. We work in collaboration with partners and focus on five transitions that we have identified together with our stakeholders: (1) Industry: from economic stagnation to growth in high-technology industry, (2) Healthy Living: from illness and treatment to health and behavior, (3) Defence, Safety & Security: from a wide range of threats to controllable risks, (4) Urbanisation: from urbanisation bottlenecks to urban vitality and (5) Energy: from conventional sources to sustainable energy systems.*

### **About ECN**

*Energy research Centre of the Netherlands (ECN) is the largest energy research institute in the Netherlands. ECN develops new technology and conducts pioneering research in various ways into innovative solutions to facilitate the transition to sustainable energy management. With around 500 members of staff, we are active in projects both at domestically and abroad, in joint efforts with the industry, government authorities and research institutes. We do this from our locations in Petten, Amsterdam and Eindhoven. ECN's research has a major influence on day-to-day life. In this, we perform an important role for the society of today and the future.*

### **About imec**

*Imec is the world-leading research and innovation hub in nano-electronics, energy and digital technologies. The combination of our widely acclaimed leadership in microchip technology and profound software and ICT expertise is what makes us unique. By leveraging our world-class*

*infrastructure and local and global ecosystem of partners across a multitude of industries, we create groundbreaking innovation in application domains such as healthcare, smart cities and mobility, logistics and manufacturing, and energy.*

*Imec is also a partner in EnergyVille ([www.energyville.be](http://www.energyville.be)), an association of the Flemish research centers KU Leuven, VITO, imec and UHasselt in the field of sustainable energy and intelligent energy systems.*

*As a trusted partner for companies, start-ups and universities we bring together close to 3,500 brilliant minds from over 70 nationalities. Imec is headquartered in Leuven, Belgium and also has distributed R&D groups at a number of Flemish universities, in the Netherlands, Taiwan, USA, China, and offices in India and Japan. In 2015, imec's revenue (P&L) totaled 415 million euro and of iMinds which is integrated in imec as of September 21, 2016 52 million euro. Further information on imec can be found at [www.imec.be](http://www.imec.be)*

*Imec is a registered trademark for the activities of IMEC International (a legal entity set up under Belgian law as a "stichting van openbaar nut"), imec Belgium (IMEC vzw supported by the Flemish Government), imec the Netherlands (Stichting IMEC Nederland, part of Holst Centre which is supported by the Dutch Government), imec Taiwan (IMEC Taiwan Co.) and imec China (IMEC Microelectronics (Shanghai) Co. Ltd.) and imec India (Imec India Private Limited), imec Florida (IMEC USA nanoelectronics design center).*

### **About Dyesol**

*Dyesol is a global leader in the development and commercialisation of Perovskite Solar Cell (PSC) technology – 3rd Generation photovoltaic technology that can be applied to glass, metal, polymers or cement. Dyesol manufactures and supplies high performance materials and is focussed on the successful commercialisation of PSC photovoltaics. It is a publicly listed company: Australian Securities Exchange ASX (DYE) and German Open Market (D5I).*

### **About Solartek**

*Solartek Ltd. is a company registered in Russian Federation and located at Troitsk, Moscow. Solartek is an industrial partner of the Solliance. Six venture-building Nanotechnology Centers are investing Solartek as the joint company which playing the role of the business incubator and IP-box in photovoltaics. Solartek is creating different types of business - from small scale PV-FABs to BIPV-product companies. In the framework of Solliance perovskite-PV and CIGS-PV research activities Solartek is developing and supplying the samples of advanced PV materials (CNT-based conductive films) for conducting tests, aimed on cutting the production costs of PV products.*

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