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Singapore-Based Tera-Barrier Films Receives Investment from Applied Ventures to Commercialize Moisture-Resistant Films for Plastic Electronics

Applied Ventures, LLC, the venture capital arm of U.S.-based Applied Materials, Inc., a global leader in nanomanufacturing technology solutions, invests in Tera-Barrier Films Pte. Ltd., a newly incorporated spin-off from A*STAR's Institute of Materials Research and Engineering (IMRE)

Singapore, 25 August 2009 | USA, CA, 24 August 2009 – Tera-Barrier Films Pte. Ltd., a new spin-off from the Singapore Agency for Science, Technology and Research's (A*STAR) Institute of Materials Research and Engineering (IMRE), today announced that Applied Ventures, LLC, the venture capital arm of Applied Materials, Inc. has made a strategic investment in the company. The funds will be used for the development and manufacture of a new proprietary, moisture resistant film that can significantly extend the life span of devices such as organic solar cells and flexible displays.

Tera-Barrier Films was founded by two A*STAR IMRE's researchers, Dr. Mark Auch and Mr. Senthil Ramadas, who will serve as the company's CEO and CTO, respectively. The ultrahigh barrier film technology was successfully developed at IMRE and the barrier properties were validated by solar and flexible display manufacturers. Tera-Barrier is still closely linked to IMRE as it operates under a laboratory-in-a-research institute scheme, allowing research continuity and the uninterrupted development of the films.

The new film protects the easily degraded moisture-sensitive organic materials of plastic devices and targets the burgeoning plastic electronics industry. Applications of the film include the manufacturing of flexible, lightweight and cheap electronics such as disposable or wrap-around displays, identification tags, low cost solar cells and chemical- and pressure-sensitive sensors.

"This investment is in line with Applied Materials' strategy to spur development of a broad range of products that not only serve customers' needs, but conserve the

Earth's natural resources, and make alternative energy and environmental solutions more accessible and affordable," said J. Christopher Moran, vice president and general manager of Applied Ventures. "We are pleased that our investment in Tera-Barrier will be used to support the commercialization of this breakthrough technology to enable a new generation of advanced devices."

Tera-Barrier Films is a portfolio company of Exploit Technologies Pte. Ltd., the marketing and commercialization arm of A*STAR. Tera-Barrier has signed a license agreement with Exploit Technologies to obtain the rights to develop and market products using the breakthrough flexible substrate technology.

Mr. Boon Swan Foo, Executive Chairman of Exploit Technologies said, "We are encouraged to have attracted such interest from Applied Materials, a global leader in the field of nanomanufacturing technology solutions. This is a strong endorsement of A*STAR IMRE's technology and of Tera-Barrier Films's long term development and marketing plans; especially so in the current economic climate, where corporate investments have slowed down significantly. We believe this investment will move Tera-Barrier Films in the right market direction.

"Just as we have taken an active role since flexible film's early days to shape the business plan, raise funds and eventually start the company, we are looking forward to working with Applied Materials in continuing our efforts to grow the company. Exploit Technologies hopes to collaborate with more such committed industry players to bring a robust pipeline of A*STAR's technologies to market like flexible substrates, and support promising start-ups like Tera-Barrier Films."

"The investment by Applied Ventures enables Tera-Barrier to move forward with commercialization plans into the flexible solar cells and printed electronics market", comments Dr. Mark Auch, CEO of Tera-Barrier Films. "Tera-Barrier Films is in the process of securing product qualification and sample orders and has strong subcontract partnerships in place for scalable production of high performance barrier films. We are excited to be able to bring to market a key enabling product that could help promote faster growth in our target markets."

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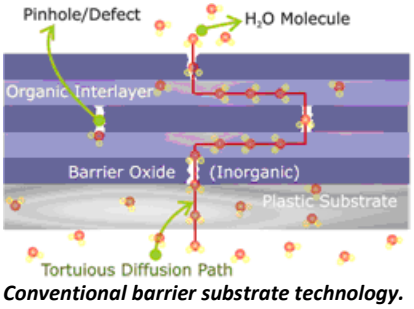
Notes to the Editor on flexible substrate technology

NOTE TO EDITOR ON THE PROPRIETARY FLEXIBLE SUBSTRATE TECHNOLOGY

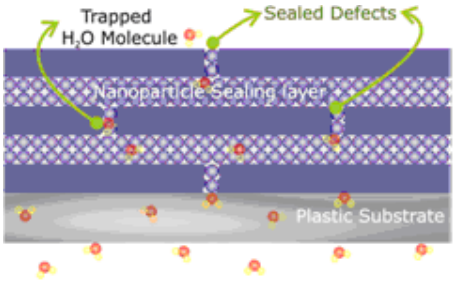
The performance of devices like organic light emitting diodes (OLEDs) and solar cells is sensitive to moisture because water and oxygen molecules seep past the protective plastic layer over time and degrade the organic materials that form the core of these products. Current commercially available films used to protect these materials have a barrier property or water vapor transmission rate of about $10^{-3}g/m^2$ per day, or one thousandth of a gram per square meter per day at 25°C and 90% relative humidity (RH). However, the ideal film for organic devices would require a barrier property of better than $10^{-6}g/m^2$/day at 39°C and 90% RH, or one millionth of a gram per square meter per day.

Defects such as pinholes, cracks and grain boundaries are common in thin oxide barrier films when fabricated onto plastic substrates. These defects cause a 'pore effect', where oxygen and water molecules are able to seep through and penetrate the plastic barrier. Current barrier technologies focus on reducing these defects by using alternate organic and inorganic multi-layers coated on plastic. These multiple layers "stagger" corresponding pores in adjacent layers and create a 'tortuous', lengthy pathway for water and oxygen molecules, making it more difficult to travel through the plastic.

In contrast, A*STAR's IMRE has taken an innovative approach to resolve the 'pore effect' by literally plugging the defects in the barrier oxide films using nanoparticles. This reduces the number of barrier layers needed in the construction of the barrier film down to two layers in this unique nanoengineered barrier stack. IMRE's barrier stack consists of barrier oxide layers and nanoparticulate sealing layers. The nanoparticles used in the barrier film have a dual function - not only sealing the defects but also actively reacting with and retaining moisture and oxygen.

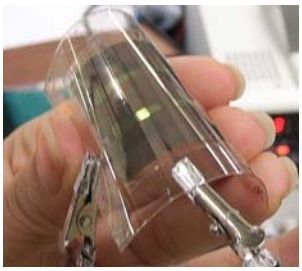


Conventional barrier substrate technology.



IMRE's barrier substrate technology 'plugs the gaps' in technology.

The result is a breakthrough moisture barrier performance of better than 10^{-6} g/m^2/day, or one millionth of a gram per square meter per day, which surpasses the requirements for flexible organic device substrates. The barrier film also has a lag time of more than 2,300 hours at 60°C and 90% RH (i.e. the time required for moisture to pass through the barrier film under those conditions). These plastic barrier properties were tested and validated by the Centre for Process Innovation, UK.



IMRE's flexible substrates have higher barrier properties compared to existing market technologies thus potentially enhancing the lifetime of existing thin film photovoltaic solar cells, inorganic EL displays and other flexible electronics products.

Flexible barrier substrates enable greater cost savings in manufacturing such as in allowing roll-to-roll processing.

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About Exploit Technologies Pte Ltd

Exploit Technologies is the strategic marketing and commercialisation arm of the Agency for Science, Technology and Research (A*STAR). Its mission is to support A*STAR in transforming the economy through commercialising R&D. Exploit Technologies enhances the research output of A*STAR scientists by translating their inventions into marketable products or processes. Through licensing deals and spinoffs with industry partners, Exploit Technologies is a key driver of technology transfer in Singapore. It actively engages industry leaders and players to commercialise A*STAR's technologies and capabilities, bridging the gap from Mind to Market. Exploit Technologies' charter is to identify, protect and exploit promising intellectual property (IP) created by A*STAR's research institutes.

For more information, please visit www.exploit-tech.com.

About Applied Ventures, LLC

Applied Ventures, LLC (www.appliedventures.com), a subsidiary of Applied Materials, Inc. invests in early stage technology companies with high growth potential that provide a window on technologies that advance or complement Applied Materials' core expertise. Applied Ventures' investments help develop technologies and markets that provide natural extensions of Applied Materials' businesses and can stimulate the growth of applications for its products and services. Applied Materials, Inc. (Nasdaq:AMAT) is the global leader in Nanomanufacturing Technology™ solutions with a broad portfolio of innovative equipment, service and software products for the fabrication of semiconductor chips, flat panel displays, solar photovoltaic cells, flexible electronics and energy efficient glass (www.appliedmaterials.com).

About Tera-Barrier Films Pte. Ltd.

TERA-BARRIER FILMS is jointly founded by Senthil Ramadas and Mark Auch along with ETPL. TBF is a spin-off company from the Institute of Materials Research and Engineering/A*STAR The strong patent portfolio (29 patents) on transparent gas barrier technology, encapsulation and gas permeation measurement system has been transferred to the company. The technology know-how and expertise could provide a total barrier solution for flexible solar cell and flexible electronics device manufacturers. Tera-Barrier is working in nexus with solar, display and printed electronics customers and has received several product validation reports.