Prototype tools for mass producing nanostructures to launch in Singapore

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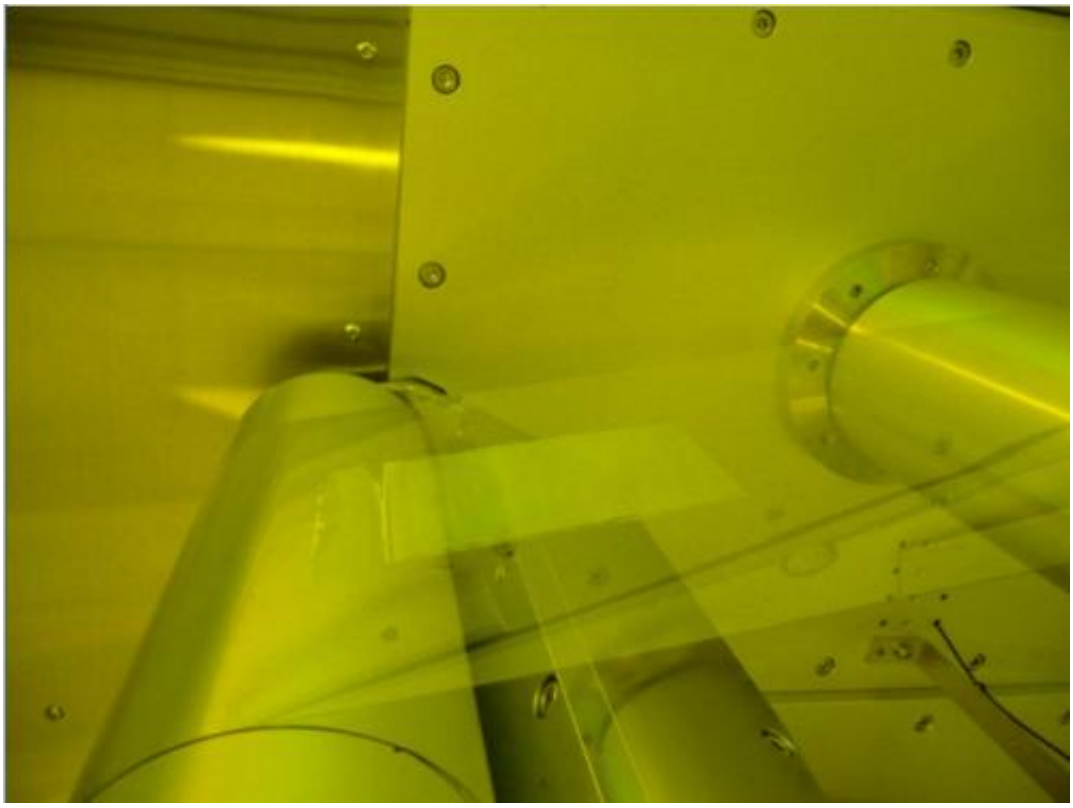

One of the square plastic films bearing nanometer-sized patterns being rolled out of the prototype roll-to-roll UV nanoimprinter - Roll-to-roll processing will allow such unique plastics to be manufactured on a large scale. Copyright : Agency for Science, Technology and Research

The Industrial Consortium On Nanoimprint (ICON), which is helmed by the Institute of Materials Research and Engineering (IMRE), a research

institute of Singapore's Agency for Science, Technology and Research (A*STAR), is ready to put roll-to-roll nanoimprint manufacturing to the test.

Nanoimprinted structures and components are being used in items such as anti-reflection films, and solar cells. However, their impact in consumer products is limited as viable manufacturing processes to scale-up the production of such nanostructures is lacking. IMRE and its partners in ICON are planning to manufacture the structures, using a roll to roll process. This fast, mass production method can create large area nanostructured components, opening the way for new consumer applications not previously conceptualised or economically feasible.

Roll-to-roll imprinting is the third industry-themed project by ICON that includes local and international partners such as Solves Innovative Technology Pte Ltd (Singapore), Advanced Technologies and Regenerative Medicine, LLC (ATRM) (USA), Young Chang Chemical Co. Ltd (South Korea), EV Group (Austria), Micro Resist Technology GmbH (Germany) and NTT Advanced Technology Corporation (Japan). The partners who are raw material providers, tool-makers, and end-users represent the entire value chain for producing nano-structures and putting them to use. Some of the applications that the consortium hopes to harness with roll-to-roll nanoimprint include anti-fouling surfaces, anti-reflection films to enhance the efficiency of solar cells, wire-grid polarisers, and optical films for flat panel displays.

"The roll-to-roll nanoimprinting technique is a crucial centerpiece in ICON's plan to complete the value chain for harnessing the true potential of our bio-mimetic multifunctional nanoimprint technology surfaces", said Dr Low Hong Yee, an IMRE senior scientist who heads the team developing the roll-to-roll nanoimprint technology. "With this method we can merge nanoimprint technologies into real-world applications and on an industrial scale", explained Dr Low, adding that the engineered

materials that are produced can be made for a variety of applications. For example, nanostructures can be used to mimic patterns of surfaces found in nature to endow the synthetic surfaces with properties such as inherent colour effects, tack-free adhesion to surfaces, water-proofing and anti-reflectivity.

ICON will be introducing two types of roll-to-roll techniques - a thermal and a UV-based version. The thermal method makes patterns on the substrate directly, can accommodate a variety of plastics for different applications, and is ideally suited for the fabrication of micro- and nano-fluidic devices, biochemical assays as well as other biomedical applications. The UV technique allows quicker processing because it is a room temperature process, and offers the advantage of fabricating the nanostructures on cross-linkable resins, thus imparting higher thermal and mechanical stability to the imprinted products.

“The joint collaborative work with ICON to design and build the first roll-to-roll thermal nanoimprinting machine gives us the chance to work with other industry partners on how this equipment can be applied”, commented Mr Hermann Waltl, Executive Sales and Customer Support Director of EV Group, whose global headquarters is in Austria, on the roll-to-roll thermal nanoimprinter that the company has jointly developed with ICON.

“ICON provides us the opportunity to hear directly from industry about their needs so that we can customise future roll-to-roll equipment designs to specific industry requirements. ICON is all about transitioning scalable nanoimprinting techniques out of the laboratory and into the marketplace. Roll-to-roll strategies certainly fit the bill here. A lot of companies are watching the progress closely”, said Mr Koh Teng Hwee, Managing Director of Solves, a small and medium enterprise that had worked with IMRE to develop the roll-to-roll UV nanoimprinting tool.

“This partnership on roll-to-roll nanoimprinting enhances our competitiveness in the global arena, particularly in helping us create new functional and patterned film technologies for displays and solar cell applications”, said Mr Kim Woo Yong, Global Marketing Director of Young Chang Chemical Co. Ltd, South Korea.

“We are happy to be involved in this groundbreaking project that will bring a new dimension to our core business and help us develop materials for a greater variety of markets and industries,” said Mrs Gabi Gruetzner, Managing Director of Micro Resist Technology GmbH (Germany), a company that specialises in providing photoresists and polymers for micro and nanolithography.

ICON is Singapore’s first nanotechnology consortium that encourages companies to adopt versatile, industry-ready nanoimprinting technology that can bring products to the market through sustainable manufacturing. Nanoimprint technology produces nanometer-sized structures of greater complexity using fewer processing steps, while minimising wastage of materials. It has evolved from a lithography technology for the semiconductor industry to a platform process technology that can be adapted to a wide range of applications. The members of ICON will gain first-hand access to these new technologies by working on joint projects to develop new products and applications that can potentially have huge savings in R&D.

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