NTU spin-off launches Singapore's first 3D-printing plant for water filtration membranes

New membranes have faster water flow than conventional filters

Nano Sun, a water technology start-up founded by a scientist from **Nanyang Technological University, Singapore (NTU Singapore)**, has launched a 3D-printing facility to manufacture a new type of water treatment membrane.
Unlike conventional membrane-manufacturing processes that use acids to make polymers porous that function as filters, Nano Sun 3D-prints millions of nanofibers layered on top of each other, compressed into a thin membrane.

This results in a new membrane that has a faster water flow rate than conventional membranes despite having a similar pollutant rejection rate. It allows for the construction of smaller wastewater treatment plants, lowering the costs for land, infrastructure and labour.

The new membrane is also more resistant to breakage and biofouling, requiring less maintenance and brings about greater cost efficiencies.

The first customers to use this next-gen membrane will be two of the largest semiconductor multinational companies in Singapore and a new municipal wastewater treatment plant in China,

which can treat up to 20 million litres of water per day – the equivalent of eight Olympic-sized swimming pools.

Nano Sun's new 3D-printing manufacturing plant is the culmination of a two-decade effort by its co-founder and **NTU Associate Professor Darren Sun** to develop and deploy his research innovations in the fields of materials science, water chemistry and advanced manufacturing, supported by the Singapore Economic Development Board.
Nano Sun's Managing Director and co-founder Mr Wong Ann Chai, said finding the right market applications and validating the membranes in a wide range of industrial and municipal wastewater recovery and intensive purification for re-use, is their current focus.
"Now that our technology has been validated, we need to able to provide the most cost-effective solution for our next phase of growth. The international market demand for industrial wastewater treatment is going strong since most countries do not want to pollute their scarce surface water and underground water resources," Mr Wong said.

"We have clinched a record value of contracts this year, and we hope to continue building our business through providing sustainable solutions such as wastewater recycling, which will help our clients save even more in the face of an upcoming increase in water tariffs in Singapore."

With the three new wastewater treatment contracts, Mr Wong said Nano Sun's annual revenue is expected to reach S$10 million this year, making it one of NTU's most successful spin-off companies to date.

Mr Gian Yi-Hsen, Executive Director, Cleantech, EDB, said: "The successful development and commercialisation of Nano Sun's unique 3D printing capabilities is an important boost to the industrial water solutions domain. In addition to helping the water sector build new efficiencies and competencies, it complements Singapore's commitment to advanced manufacturing, and is a strong testament to our robust water ecosystem and specialized talent pool."
Over the next three years, Nano Sun will expand its manpower from a Singaporean team of 18 engineers and staff to about 80, with membrane applications to be deployed in China, Indonesia and Philippines.

Since 2015, the NTU spin-off company has designed, commissioned and delivered over 15 water treatment systems and plants to various governments and companies in Singapore, China, Philippines and Indonesia.

Growing local enterprise – next generation manufacturing

NTU Vice-President of Research, Professor Lam Khin Yong said that Nano Sun's new facility and 3D nano-printed membrane are successful examples of how fundamental research in the laboratories can be transformed into products with real world impact.
"Sustainability research and water technologies are key research strengths at NTU and Nano Sun's success demonstrates how disruptive innovations developed in Singapore can help propel the industry forward in the new digital economy," said Prof Lam.

"Its rapid growth from a laboratory prototype to a full-fledged production facility was made possible by the use of NTU's innovative research in both 3D printing and water research, with help from NTU's innovation and enterprise arm, NTUitive."

He added that the university encourages and supports its faculty in innovation and commercialisation of technologies that they developed. .

3d-printed water filtration membranes
At the launch today, Nano Sun demonstrated the printing of the industry-standard PVDF (Polyvinylidene fluoride) polymer used in conventional water filtration membranes, which is approved by the United States Food and Drug Administration.

Using a proprietary 3D printer, Nano Sun can print millions of PVDF nano-fibres per second, which is accumulated on a backing material and compressed into an ultra-thin sheet of membrane.

This gives the membrane a much bigger surface area to trap or repel pollutants while allowing water molecules to pass through at a faster flow rate. By adjusting how thick or thin these unwoven fibres are layered on top of each other, the membrane can be made into microfiltration membranes and ultrafiltration membranes.

Further studies are now underway to develop even better anti-fouling additives which can be combined with other materials during the 3D-printing process.

Multi-disciplinary science and engineering
Both engineers by training, Assoc Prof Sun and Mr Wong believe that innovation is a combination of fundamental science and iterative changes based on market experience.

To keep innovating, Assoc Prof Sun has established a new research and development facility within its Tuas premises.

“When there is a disruptive innovation leapfrogging conventional processes, others will soon follow,” Assoc Prof Sun explained. “So we will need to be always one step ahead of our competitors, researching, designing and building advanced water treatment systems that are smaller, more efficient, and cost-competitive.”

Dr Ho Chaw Sing, Managing Director of the National Additive Manufacturing Innovation Cluster (NAMIC), said that the journey of an entrepreneur requires the right combination of market forces and product innovation.

“In recent years, there are not many Singapore-based product start-ups with manufacturing ambitions, due to long research-to-commercialisation cycles, and significant capital investments,” explained Dr Ho.

“NAMIC took the leap of faith with Nano Sun’s founders, convinced by their go-to-market strategy and huge market potential in waste water treatment. The social impact from their business was another big plus. Their years of effort have finally paid off, overcoming significant obstacles along the way, and culminating in their first 3D printing membrane research production facility in Singapore.”

Dr Lim Jui, CEO of NTUitive, commended Nano Sun’s CEO Mr Wong, for growing the spin-off company, from a small prototype in the lab with an office desk to a full-fledged production plant.

“Mr Wong represents a new breed of entrepreneurs who are high-flying industry veterans willing to

jump out of their comfort zone into new ventures. He has taken on substantial risk as a full-time entrepreneur, and this latest success is a credit to his vision and determination. He is a role model for our community."

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