

NUS team creates supermaterial out of old tyres in global first

Vanessa Liu

National University of Singapore (NUS) scientists have found a way to give old car tyres a new lease of life – by turning them into aerogels.

The discovery is a potential leap in closing a waste loop in Singapore.

The team from the university’s department of mechanical engineering is the first in the world to succeed in making the supermaterial out of scrap rubber.

Aerogels are the least dense solids, and have fire-retardant and insulating properties. They can be found in a range of applications, from firefighters’ suits and rockets to cosmetics and paint.

In 2018, Singapore generated

32,500 tonnes of scrap tyres, 90 per cent of which were recycled, figures from the National Environment Agency show. The rest were incinerated before ending up in landfills.

Burning rubber releases toxins into the atmosphere, which can pose safety and health threats.

Worldwide, about one billion tyres are scrapped each year. About half of these non-biodegradable materials are burned as fuel to generate energy, and 40 per cent are recycled. The rest are disposed of.

Associate Professor Duong Hai Minh, a leader of the research team, noted that rubber-tyre recycling rates are low because processing used rubber is costly and energy intensive. Recyclers also lack monetary incentive, since products made

from recycled rubber are usually of low value, he added.

“Our team decided to focus on creating rubber aerogels from used rubber tyres because they are a cheap and abundant source of raw materials,” said Prof Duong, who previously led a team which successfully constructed aerogels from polyethylene terephthalate (PET), the material that most plastic bottles are made of.

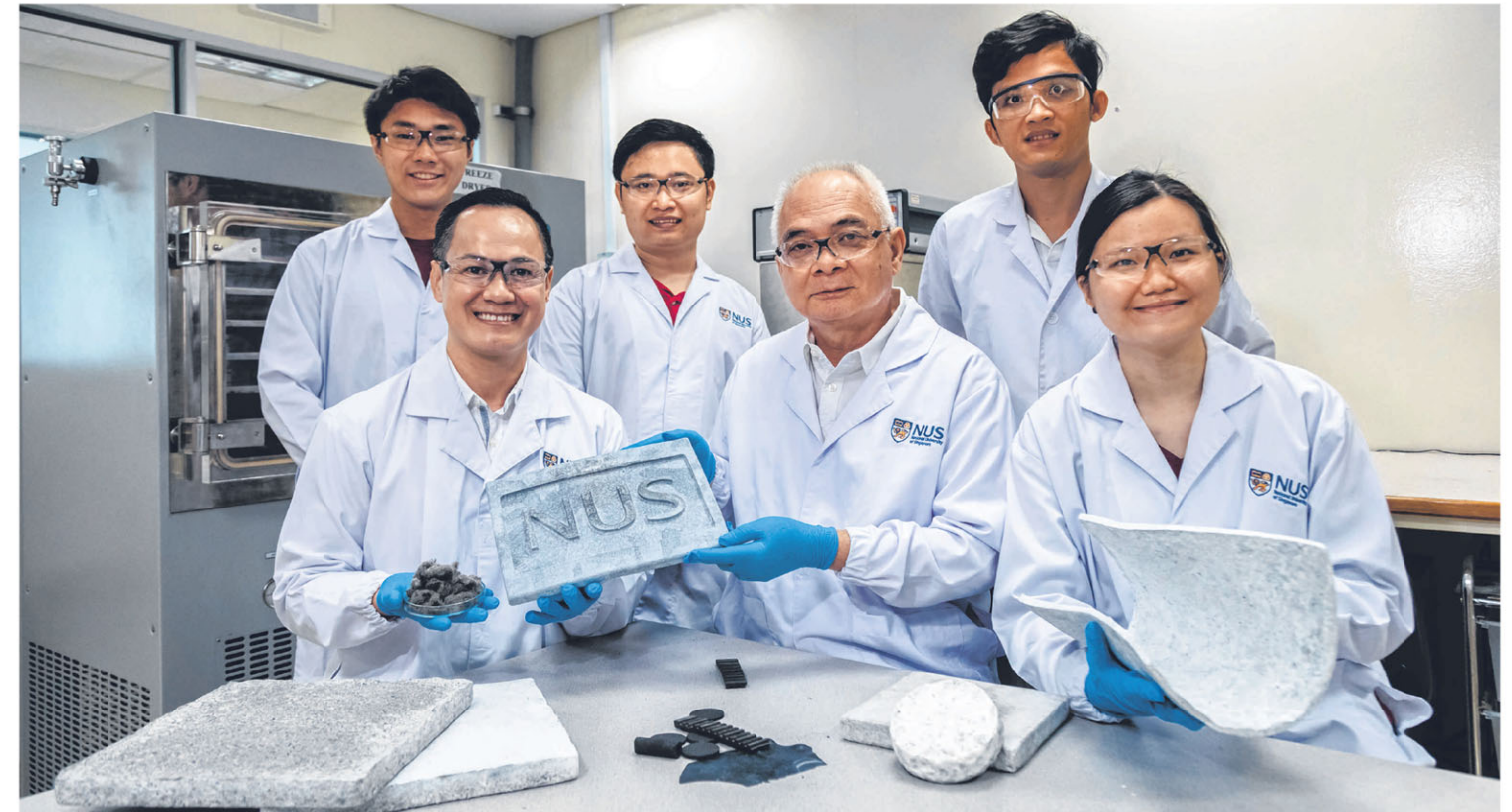
“By converting waste rubber tyres into high-value aerogels, we could enhance the monetary incentive for recycling rubber and, in turn, cut down rubber waste,” he added.

To make aerogel out of scrap rubber, the researchers shredded car tyres into fine fibres – 3mm to 8mm in length and 30 micrometres to 50 micrometres in width – and mixed them with water and solvents such as polyvinyl alcohol and glutaraldehyde.

After the mixture is stirred for 20 minutes, it adopts a gel-like form.

The gel is then freeze-dried at minus 50 deg C for up to 12 hours. This process removes all the liquid molecules in the nanopores of the gel and replaces them with air. This is why aerogels have ultra-light properties.

The entire production process



The National University of Singapore team – comprising (front row, from left) Associate Professor Duong Hai Minh, Professor Nhan Phan Thien and Ms Chong Ren Ooi, as well as (back row, from left) Mr Lim Zi En, Mr Thai Ba Quoc and Mr Le Khac Duyen – with pieces of aerogel made from scrap rubber. Their discovery of a method to create the supermaterial is a potential leap in closing a waste loop in Singapore. PHOTO: NATIONAL UNIVERSITY OF SINGAPORE

takes 12 to 13 hours. It costs less than \$10 to produce a 1 sq m sheet of rubber aerogel that is 1cm thick.

The team is now looking to scale

up production of the insulation material, which can be used not only in oil refineries and subsea systems, but also in household items such as

refrigerators as well as personal items like jackets and shoe insoles.

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