

STORY CHRISTOPHER NIESCHE

Turning trash into treasure

Veena Sahajwalla wants to shift the way we think about waste, from something to be discarded into landfill to a valuable resource and ultimately an opportunity for Australia. As the founder and head of the UNSW Centre for Sustainable Materials Research and Technology (SMaRT), Professor Sahajwalla is working on solutions to the world's biggest waste challenges, such as plastic and e-waste.

"Why would we consider end-of-life products as simply a throwaway thing when, quite clearly, we should be talking about re-manufacturing using their materials," says the professor of materials science.

Along with carrying out the scientific research, SMaRT works with industry, global research partners, not-for-profits and governments to commercialise its solutions and has developed small factories that transform problematic waste materials, such as glass, textiles and plastics, into new value-added materials and products.

Sahajwalla has a vision of these small modular factories – dubbed MICROfactories – dotted around Australian cities and regions, diverting waste from landfill and producing valuable materials and products instead.

Profile

Professor Veena Sahajwalla

The globally recognised materials scientist, engineer and inventor is revolutionising the science of recycling through her work at the UNSW. Born in Mumbai, she was educated in India, Canada (where she met her husband) and the US before moving to Australia. She appeared as a judge on the long-running ABC TV series The New Inventors and on Australian Story.

SMaRT has already developed MICROfactories to transform several different types of waste.

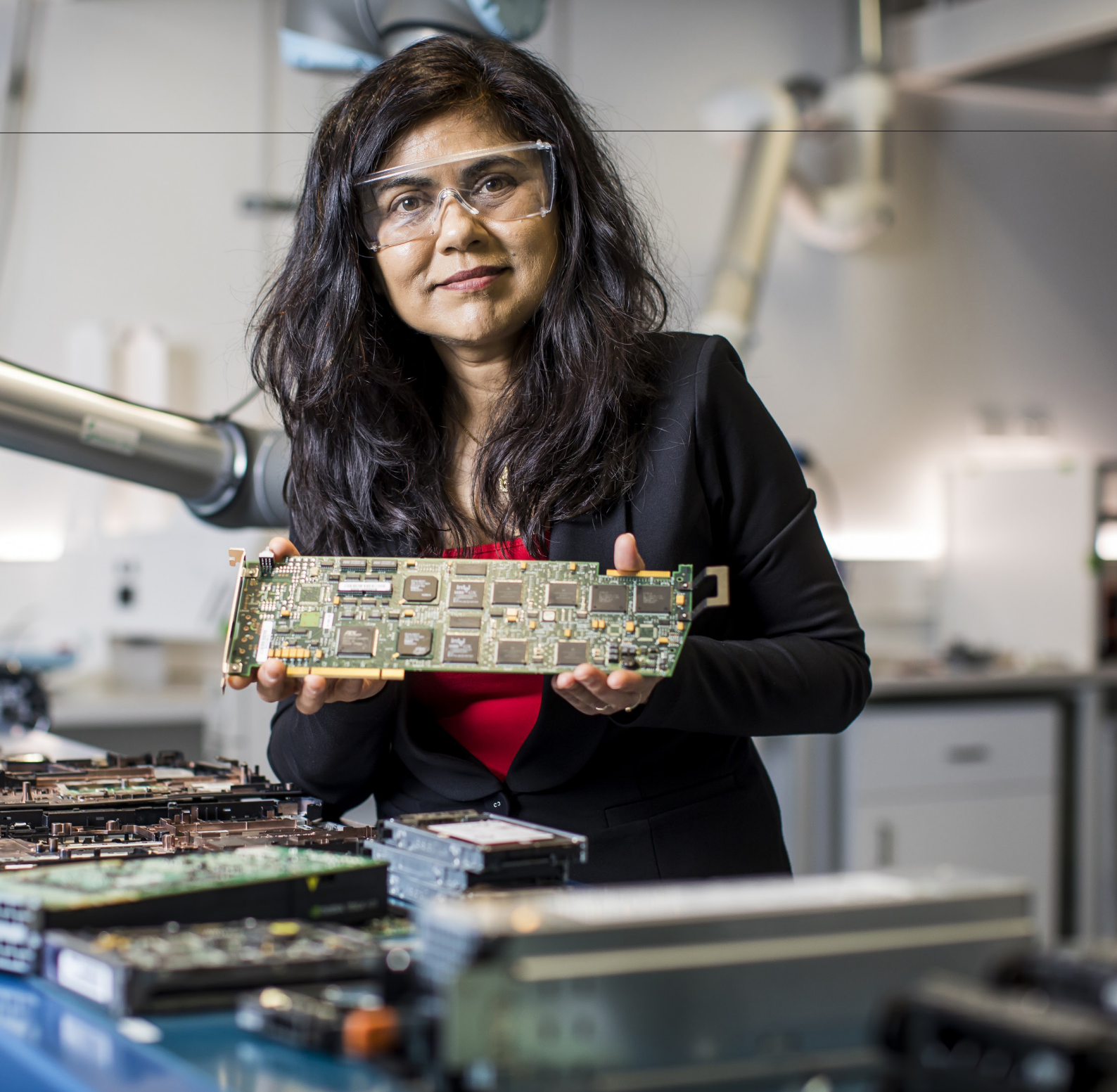
Its Green Ceramics MICROfactory in Nowra, south of Sydney, transforms waste materials, such as plastic, glass and textiles, into ceramics for use in buildings, as furniture and ceramic tiles, and for various architectural and decorative applications. The Plastics

Filament MICROfactory, onsite at UNSW, uses a variety of waste plastics to create valuable filament for 3D printing. Other MICROfactories produce green metals and green aluminium and transform e-waste.

"MICROfactories are all about creating these modular solutions as close as possible to where the waste is and very much focusing on creating those value-added materials or products," she says. "You have to be able to demonstrate that the pathway to achieving the output is a



PHOTOGRAPHY BY ANNA KUCERA



lot better than just simply moving waste around the world.”

Sahajwalla says that reusing and recycling materials is in her DNA, thanks to her childhood in India.

“I grew up in Mumbai and learned that there are many different ways in which we can show care and compassion,” says Sahajwalla.

“If you’ve got an excess of something, you don’t have to throw it away. You can actually make that available to those that are less privileged.”

It’s why she still gets her shoes mended instead of throwing them away.

“Can I afford to go and buy new pairs of shoes?” she asks. “Yeah, sure, I can. But would I want to? No, because from my perspective, it’s a different thing that motivates me.”

Sahajwalla says she has always been careful with her money. As a child, she kept her pens and pencils in a glass jar rather than spending her money on a pencil holder. She prefers to spend money with a purpose and with an eye to the

Adding value... Veena Sahajwalla at the UNSW’s SMaRT Centre’s demonstration e-waste MICROfactory.

long term, and says the habit helped her and her husband buy their home. It’s a lesson she learned from her parents, who didn’t have much compared with the high cost of living in Mumbai. “Some habits never really die once they become part of who you are,” she says.

And her mother is still drumming home the lesson. A recent fall meant



New lease on life... team members at the UNSW's SMaRT Centre's demonstration Green Ceramics MICROfactorie.

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her mother needed live-in help to remain in the family home in India and Sahajwalla and her brother stepped in to meet the cost, just as their parents supported their own parents in years past.

“Oh, you guys are spending way too much money,” her mother tells her and her brother.

She is pleased to have the option of spending the money to care for her mother and to meet other unplanned financial events.

When she considers her superannuation, she ensures that her investments align with her values, particularly caring for the environment.

“It’s never about making a quick buck,” she says. “It’s looking at it from a from a holistic perspective and how your values align with where you’re actually investing your money.”

Her biggest financial indulgence is buying “a crazy expensive” brand of ice-cream. Recently this turned into a major financial indulgence when she ended up with a severe toothache and had to pay for a weekend visit to the dentist.

Next steps after recycling

Sahajwalla is applying a similar lens to the waste problem as she does to the worn-out soles of her shoes. Instead of just tinkering at the edges of the waste problem, we need a complete shift in our mindset and more creative thinking.

Recycling – the like-for-like reuse of a material such as paper or glass – has a place, but many waste products are a lot more complex than bottles or old newspapers and we need to go beyond recycling, she says. Indeed, to the ‘Three Rs of Recycling’ – reduce, reuse and recycle – Sahajwalla wants to add reform and re-manufacture.

Sahajwalla, who was already an academic at UNSW, founded SMaRT in 2008 because she didn’t

believe it was enough for her as a scientist to carry out research and then leave it to others to pick it up and commercialise.

The engineer – who did a PhD in the US before coming to Australia for a job at the CSIRO – already had one success with ‘green steel’.

She and her colleagues developed a process that leverages high-temperature reactions in electric arc furnace steelmaking to transform waste tyres in the production of high-quality steel.

In a process known as green steel polymer injection technology, rubber crumbs from tyres are injected into a furnace, which liberates the hydrogen needed to extract the oxygen from iron oxide to leave iron. The technology, supported by Australian steelmakers and the Australian Research Council, is attracting global interest, says Sahajwalla.

That is what she calls Gen 1 green steel. The next step is to find sources of the hydrogen and carbon needed in steelmaking, which is currently provided by coke and coal. SMaRT is experimenting with waste coffee grounds and plastics – they are a rich source of solid carbon, which is an essential element in the making of steel alloys. The new process will also be more efficient and SMaRT has carried out tests in electric furnaces to collect data to quantify the economic viability of the technology in an industrial setting.

The work could ultimately eliminate the need to use any coal in electric steelmaking furnaces.

“If you’re going to save on energy and if you’re going to save on materials – as in you’re going to use more recycled materials – then ultimately it’s a win-win outcome,” she says.

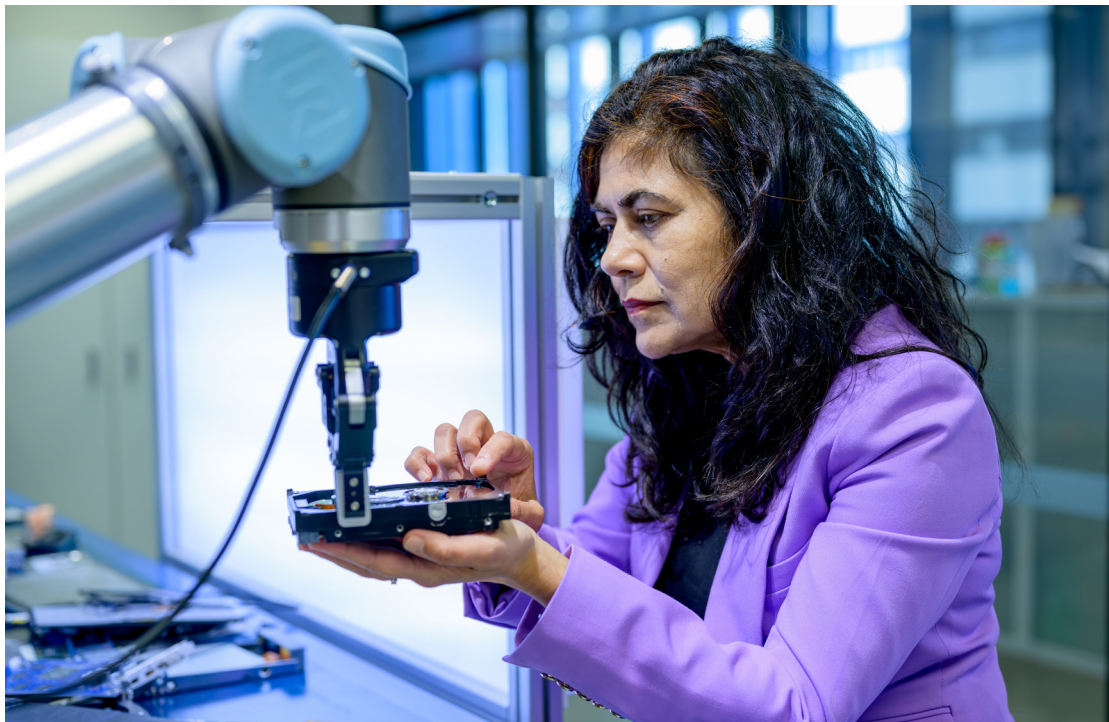
For this and other re-forming and re-manufacturing processes to take off, they need to be economically viable. “It’s not just about saying, well, I’m really trying to be nice and green, and everyone please do the right thing,” she says. “It’s got to be competitive from a performance point of view and a quality perspective. The fact that it’s got recycled materials in it is a nice bonus.”

She points to the green ceramics MICROfactorie in Nowra as an example of an economic success.

Role for ‘the clever country’

Sahajwalla believes e-waste will be the next big frontier in problematic waste. Australia is an importer of batteries, laptops, phones, televisions and myriad other electronic devices, and they contain large amounts of metallic elements.

“The end-of-life products sure belong to us. And if the end-of-life products belong to us, then it’s a massive opportunity for us to really tap into what’s literally in it,” she says. “If we are going to imagine a future in Australia where high-performance



Pioneering work... Veena Sahajwalla examines an old hard drive on SMaRT's e-waste disassembly line.

Below, from left: Printed circuit board components from e-waste entering a furnace to recover valuable metals. The materials recovered from the thermal disengagement process within the furnace. A ceramic tile produced within SMaRT's Green Ceramics MICROfactorie from waste glasses and textiles.

products are being made, then for us to be really clever in the way we look at e-waste is going to be super important."

What we need are small factories in cities and regions that can extract the metallic and non-metallic materials for reuse.

SMaRT is pioneering microrecycling science for future MICROfactorie technologies that could transform e-waste into value-added materials, including essential alloys that can be used again as a new resource in the re-manufacturing ecosystem. Plastics from e-waste can also be re-formed into a valuable filament for 3D printing and as a feedstock for manufacturing.

The UNSW research centre is now in partnership with businesses and organisations and Sahajwalla says collaboration between research and technology and enterprise is essential for creating what she calls "the transformational pathways" for waste to be converted into valuable materials. "We have to challenge the norm," she says.

She believes that since SMaRT was founded about 15 years ago, attitudes have changed and she is now having sophisticated conversations about waste with communities, governments and businesses. But there is still a way to go.

She points to the strong safety culture that Australian workplaces have developed,

noting that the motivation isn't just economics, but also keeping workers safe.

Likewise, she believes there is an impetus in Australia beyond economics alone that will drive the widespread reuse of waste, although financial feasibility remains important.

"I think we've got an opportunity to rethink the circular economy and talk about that narrative in an Australian context. What excited me about living here was the care for people," she says. "I think we can absolutely do it. It matters from an economic point of view because a lot of these important materials are materials that could be limited resources." ■

