UNSW Sydney

UNSW Library
Special Collections & Exhibitions

Materials Revolution

Large print
Exhibition guide

Main Library

PLEASE RETURN FOR OTHERS TO USE

Introduction

Materials Revolution is an exhibition showcasing transformative research by the UNSW Sustainable Materials Technology and Research (SMaRT) Centre to express a paradigm shift in how we need to view and utilise materials. Just as the Industrial Revolution reshaped 18th-century manufacturing with machines and the Technological Revolution of the 20th century brought us computers, *Materials Revolution* focuses on the transformation of materials themselves. This involves a significant rethinking of how we extract, produce, consume, and dispose of materials to reduce environmental impacts and excessive waste generation. Materials scientists and engineers are developing technologies that move from a linear manufacturing model of 'take, make, dispose' towards a circular economy system where materials from end-of-life products are recognised as valuable feedstock for future manufacturing needs.

The UNSW SMaRT Centre is a dynamic fulcrum for interdisciplinary collaboration, pioneering technologies that reform hard-to-recycle waste streams into valuable industrial inputs. Founded in 2008 by ARC Laureate (2014) and ARC Industry Laureate (2023) Fellow, Scientia Professor Veena Sahajwalla AO, the UNSW SMaRT Centre tackles the critical issue of developing innovative solutions for problematic wastes not subject to conventional recycling. Through the pioneering concept of 'microrecycling science', SMaRT has developed cutting-edge technologies and MICROfactories™ that transform complex wastes into valuable materials and products, fostering resource circularity. By leveraging microrecycling science, diverse waste streams such as glass, textiles, e-waste, batteries, and plastics are transformed into new products, such as Green Metals, Green Ceramics™ and 3D printing filament. The Green Steel™ Polymer Injection Technology (PIT), also developed by SMaRT, uses waste rubber as a partial replacement for coke and coal needed in electric arc furnace steelmaking. Green Steel™ PIT enhances production efficiency, reduces emissions, and amplifies yields. These groundbreaking recycling practices embody the principles of a circular economy, paving the way for a more sustainable and resilient future.

Materials Revolution was developed by UNSW Library in collaboration with the UNSW SMaRT Centre.

Acknowledgement

UNSW SMaRT Centre would like to acknowledge:

- Australian Battery Recycling Initiative (ABRI)
- Advanced Manufacturing Growth Centre (AMGC)
- Australian Research Council (ARC)
- Bradken
- Jamestrong Packaging
- Kandui Technologies
- Manhari Recycling
- Mattress Recyclers Australia
- MolyCop
- National Environmental Science Program (NESP)
- Nespresso
- Noveco Surfaces
- NSW Office of Chief Scientist and Engineer
- Planet Ark
- Renew IT
- Shoalhaven City Council
- SMaRT MICROfactories™
- Sydney Water
- Textiles Recyclers Australia
- Trailblazer for Recycling and Clean Energy (TRaCE)
- UNSW Sydney

UNSW Library Exhibitions team has taken steps to reduce the environmental impact of this exhibition and to develop sustainable design practices that we will continue into the future. This includes prioritising using recycled, reclaimed, or repurposed materials, sourcing products from local suppliers to minimise transport, and building relationships with businesses that incorporate reuse and/or recycling into their materials and practices. After the exhibition, all cardboard, textile, and 3D printed materials will be provided to SMaRT for reuse or recycling.

We would like to acknowledge the fabricators and suppliers used in this exhibition:

UNSW SMaRT provided 3D printed display mounts, printed from recycled e-waste filament supplied by Renew IT (Lane Cove, NSW).

UNSW Design Futures Lab provided 3D printed display mounts, printed from recycled plastics sourced from Standard Print Co. (Chippendale, NSW), and fabricated custom plinths made from cold-pressed recycled plastic sourced from Defy Designs (Botany, NSW).

UNSW Print Centre provided printed materials on paper made with 100% recycled post-consumer waste.

Digital Fabrics (Marrickville, NSW) produced textile banners, woven from 100% recycled polyester yarn.

Lite Corp (Wallerawang, NSW) provided the recyclable honeycomb cardboard used for signage and display, made from 80% recycled materials.

Resourceful Living (Kurri Kurri, NSW) provided advice and successfully experimented with the recycling of plastic vinyl signage from previous Library Exhibitions, soon to be reformed into custom products.

UNSW Library also acknowledges the support of Powerhouse in loaning collection objects and display assets for this exhibition. By repurposing Powerhouse's existing display materials rather than fabricating new custom showcases, we were able to reduce our resource consumption and minimise waste.

Video: *Australian Story (2021), Ep 3, The Tipping Point*
Single-channel video with sound, 29:23 minutes

Green Steel™

In 2003, Professor Veena Sahajwalla AO and her team developed Green Steel™ Polymer Injection Technology (PIT). This innovative technology leverages the crucial elements of hydrogen and carbon from waste tyres and plastics, using these wastes as a partial substitute for coking coal in electric arc furnaces steelmaking. The carbon is locked into the newly made steel, while the essential and emission-free hydrogen improves the process. This groundbreaking technology reduces the dependency on fossil fuels in steel manufacturing and improves production efficiency and yield while finding a solution for the millions of tyres that end up in landfills each year.

Traditional steelmaking processes require coal and other fossil fuels to generate the heat levels required to melt and refine the iron in iron ore. Reliance on fossil fuels contributes to greenhouse gas emissions and environmental pollution. However, Green Steel™ PIT offers a more sustainable alternative by replacing a portion of the coal and coke with recycled polymers. This diverts end-of-life vehicle tyres from landfills and repurposes them as raw materials in Green Steel™ production.

Industry partners have played an important role in Green Steel™ development to bridge the gap between research and commercial implementation. The early industry partnership with OneSteel demonstrated the commercial feasibility of utilising recycled materials in steel production. OneSteel employed PIT in existing electric arc furnace steelmaking processes. UNSW SMaRT Centre has been working with industry partner Molycop to develop “Next Generation” Green Steel™ PIT, aiming to enhance PIT performance metrics and leverage the benefits of releasing hydrogen into the process. PIT has been used in various furnaces around the world under license to UNSW. While blast furnaces face limitations in integrating high volumes of waste materials due to their coke-based heat generation, electric arc furnaces offer greater flexibility for incorporating recycled materials, making them more suitable for Green Steel™ PIT manufacturing.

Rubber

Rubber for tyre manufacturing primarily comes from two sources: natural rubber and synthetic rubber. Natural rubber is harvested from rubber trees by tapping the bark, allowing the milky sap (latex) to flow and solidify into rubber. Synthetic rubber is produced through chemical processes using petroleum-based materials. Because tyres are made with both natural and synthetic materials, they are very slow to decompose. It can take over 80 years for a vehicle tyre to break down in a landfill. According to the recent consumption report prepared by Tyre Stewardship Australia, Australia has over 21 million registered road vehicles and generated an estimated 537,000 tonnes of waste tyres in 2023-24. Green Steel™ Polymer Injection Technology has prevented millions of waste rubber tyres from entering landfills, demonstrating the positive environmental impact of this innovative approach to steelmaking.

Under the Sustainable Communities and Waste (SCaW) Hub, which SMaRT leads, the Centre is working to better understand microplastics and reduce the effects of these particles on the environment. The microparticles generated by tyres during their lifetime form a key focus area of this research. Preliminary analysis shows microparticles from tyres are constantly present as pollutants in samples collected from stormwater drain filters. The microplastics project seeks to find ways to reduce the impacts of microplastics before they enter waterways.

Image: Carbons from tyre dust under high-resolution scanning electron microscopy (SEM).
Credit: UNSW SMaRT Centre

Object: Furnace on stand, various materials, designed and made by Ceramic Engineering, 1990-1999, modified by the SMaRT group at UNSW, Sydney, New South Wales, Australia, 2003
Credit: Powerhouse collection, Gift of Centre for Sustainable Materials Research & Technology (SMaRT@UNSW), 2016

Framed photographs: Green Steel™ Furnace at Molycop
Credit: UNSW SMaRT Centre

Film still from *Wonderful Waste (2023), Episode 05, Veena Sahajwalla*. Produced by Never Too Small.
Credit: New Mac Video Agency

Display case contents

School of Materials Science and Engineering Group - including Dr Veena Sahajwalla (Senior Lecturer) (third from left) and the lab manager, Narendra Saha Chaudhury. 1998
Credit: UNSW Archives. 00A33/9/2/15

"Talking about steel making," *UNIKEN*, no. 16, 26 September 1997, page 3.
Credit: UNSW Archives. S328.

Green Steel™ Furnace at Molycop.
Credit: UNSW SMaRT Centre

Professor Veena Sahajwalla with a Green Steel™ Furnace.
Credit: UNSW SMaRT Centre

Jar: Iron metal droplets produced from metal swarf.
Jar: Rubber crumbs.
Grinding media ball with test samples cut out. The surface has been modified using Automotive Shredder Residue (ASR) to create nano layers that improve hardness and durability. Credit: UNSW SMaRT Centre

Car headlight showing the complex combination of safety glass, plastic, metal film, and electronics contained within a single discarded automotive part.
Credit: UNSW SMaRT Centre

Display case contents

Various 3D printed objects made with recycled ABS plastic from e-waste and recycled PETG plastic from waste medical face shields. Credit: UNSW SMaRT Centre

A series of aluminium cans depicting the assembly sequence of commercial product packaging. Scientists from SMaRT are currently working with Jamestrong Packaging to use Green Aluminium technology in their products.
Courtesy of Jamestrong Packaging
Jar: Waste coffee capsule.
Jar: Coffee capsule after Thermal Disengagement Technology (TDT), a technique that separates aluminium from other materials within polymer laminated packaging.
Recycled aluminium coffee capsules formed into sheets and bars following TDT. Credit: UNSW SMaRT Centre

Green Aluminium

UNSW SMaRT Centre developed a new aluminium recycling process called Green Aluminium Thermal Disengagement Technology (TDT) that effectively separates valuable materials from complex, polymer-laminated metal packaging. This microrecycling process targets multi-layered food wrapping like chip bags and coffee pods that contain a mix of plastic and aluminium. Aluminium is a silver-coloured metal that is lightweight yet strong and can be recycled repeatedly. It is often used combined with plastic in food packaging because it creates an effective barrier against oxygen, moisture, and light, protecting food from spoilage. Although aluminium can be recycled repeatedly without losing quality, it becomes difficult to separate and retrieve it in standard recycling processes, so it is not usually recycled and ends up in a landfill.

Green Aluminium TDT uses controlled heat to break down the composite packaging materials, allowing for the efficient separation and recovery of the aluminium component. This innovative process extracts high-quality aluminium with minimal waste, transforming it into a clean and reusable resource for manufacturing. The UNSW SMaRT Centre has combined TDT into its MICROfactorie™ Technologies concept, where scalable, modular units recycle complex waste streams into new products and feedstock for remanufacturing. Jamestrong, an Australian aluminium packaging manufacturer, has partnered with the UNSW SMaRT Centre to explore using recycled materials via TDT in their production process. This collaboration, supported by the Trailblazer for Recycling and Clean Energy (TRaCE) program, aims to commercialise SMaRT's innovative Green Aluminium TDT and MICROfactorie™ Technology to position Jamestrong as a leader in sustainable aluminium can manufacturing.

Aluminium is also a key material in capsule coffee pods, particularly those designed for single-serve coffee machines. The UNSW SMaRT Centre partnered with Nespresso to apply TDT to the polymer laminated aluminium packaging (PLAP) in coffee pods. Because aluminium is lightweight, durable, and easily formed into various shapes, it is a versatile packaging option for these single-use pods. TDT enables its recovery in waste coffee pods 'contaminated' with coffee residue, transforming it into a high-quality material for remanufacturing.

Aluminium

Aluminium production is an energy-intensive, multi-stage process. The process starts with mining bauxite, a sedimentary rock rich in aluminium. The bauxite ore is then refined to extract alumina. Finally, the alumina is smelted (a process using heat and a reducing agent to extract metals) to produce pure aluminium, which requires large amounts of energy. Large bauxite deposits in Western Australia and Queensland are mined in open-pit mines, making Australia the world's largest producer. Open-cut bauxite mining involves clearing vast land areas and stripping the topsoil, leading to long-term land degradation and increased fire risk while also contributing to water pollution and carbon emissions. According to the Australian Aluminium Council, recycling aluminium saves 95% of the energy needed to make new aluminium. With Australia extracting close to 100 million tonnes of bauxite per year, processes like Green Aluminium TDT are crucial for sustainability as they significantly reduce energy consumption and environmental impact compared to primary production.

Image: Recovered Aluminium alloy from waste coffee capsule under high-resolution scanning electron microscopy (SEM). Credit: UNSW SMaRT Centre

Installation of polymer-laminated food packaging
Credit: UNSW Library

Object on plinth: Waste coffee pods, an example of polymer laminated aluminium packaging (PLAP).
Credit: UNSW SMaRT Centre

Custom plinths fabricated by UNSW Design Futures Lab made with cold-pressed recycled plastic.

Video: *Molycop Green Steel™*
Silent single-channel video, 2:07 minutes
Credit: Footage supplied by UNSW SMaRT Centre

Plastics Filament MICROfactorie™ at Renew IT
Silent single-channel video, 1:35 minutes
Credit: Footage supplied by UNSW SMaRT Centre

Smart Recycling
Silent single-channel video, 1:58 minutes
Credit: Footage supplied by UNSW SMaRT Centre

E-waste and Green Metals
Silent single-channel video, 1:41 minutes
Credit: Footage supplied by UNSW SMaRT Centre, edited by UNSW Library

Plastics Filament

ABS plastic is one of the most common materials used in electronic appliances due to its flexibility, impact resistance, and electrical insulation properties. It forms the basis of keyboards, computer and laptop enclosures, printer casings, routers, plugs, and connectors. The increased production and consumption of these devices, combined with their relatively short lifespans, has led to a growing problem of electronic waste (e-waste) on a global scale. Given the prevalence of plastic in these products, there is an urgent need to find ways to reclaim and reuse this material.

Between 2014 and 2020, a team of UNSW SMaRT Centre researchers led by Prof Veena Sahajwalla, under the ARC Green Manufacturing Research Hub, collaborated with leading e-waste recycler TES-AMM. This partnership resulted in the transformation of plastics from e-waste into the first sustainable plastic filament for 3D printing, using thermal transformative techniques and other innovations. The filament, made from 100% recycled plastic, exhibits outstanding physical properties such as the strength and flexibility required of ABS. 3D printing allows it to be reformed into complex shapes for countless applications.

This research has helped the UNSW SMaRT Centre develop the building blocks for its breakthrough MICROfactorie™ Technologies and advance its microrecycling science research. Instead of collecting and transporting large amounts of plastic waste to centralised processing facilities, SMaRT's MICROfactorie™ Technologies enable waste to be processed at the point of collection. The MICROfactorie™ fits into a single room where several processes can take place, with discreet modules that transform the waste into different end-products. In the case of the Plastics Filament MICROfactorie™ module, the plastic is first crushed into fine shards and fed into a machine. Then, under high temperature and pressure, the waste plastic is turned into a single long filament. In this form, it can be used by 3D printers to manufacture an array of products.

This technology has recently been rolled out to commercial operator Renew IT, under license to the UNSW SMaRT Centre. With the majority of filament in Australia imported from overseas and made from petrochemicals, this new facility reduces the environmental impact of global freight and primary production, while creating a domestic supply chain through local manufacturing. With a small physical footprint, MICROfactorie™ Technologies have the potential to transform conventional recycling and create circular economies, delivering environmental, social, and economic benefits.

ABS Plastic

ABS plastic is a thermoplastic polymer made from three monomers: acrylonitrile, butadiene, and styrene. All three of these monomers are derived from crude oil through a process called cracking and refining, which contributes to carbon emissions in their primary manufacturing process.

The prevalence of ABS plastic in electronic devices means this substance has become a significant contributor to problematic waste types. Improper disposal of ABS plastics can lead to environmental pollution as it is not readily biodegradable and may release harmful chemicals if incinerated. Additionally, it is often used to encase more toxic materials that, in landfills, can contaminate the surrounding air, soil, and water.

According to the *Australian Plastics Flows and Fates Study 2021-22* (released in 2024), Australians generated 3.9 million tonnes of plastic waste, with only 13.9% being recycled. This highlights the broader challenge of plastic waste management and the need for increased efforts to keep plastics already in circulation out of landfills.

Image: ABS plastic under high-resolution scanning electron microscopy (SEM). Credit: UNSW SMaRT Centre

Framed photographs: Printed Circuit Boards (PCB) shredded and mixed together, showing different materials including aluminium, brass, tin, and copper alloys with glass fibre and epoxy resins. Further processing and purification was conducted on the sample shown to make an alloy.
Credit: UNSW SMaRT Centre

Printed Circuit Boards (PCB) shredded and mixed together, showing different materials including aluminium, brass, tin, copper, and gold alloys with glass fibre and epoxy resins. Further processing and purification was conducted on the sample shown to make an alloy. Credit: UNSW SMaRT Centre

Object on plinth: 3D printer manufactured by Comgrow. This equipment produces objects through additive manufacturing (AM), also known as 3D printing. Computer-aided design (CAD) models are transformed into physical objects by building up layers of material, such as ABS plastic filament. Credit: UNSW SMaRT Centre

Object on plinth: ABS plastic filament for 3D printing made from discarded plastic from e-waste (e.g. the plastic casing on printers). Note that the spool is 3D printed from the same ABS plastic filament. Courtesy of Renew IT

Object on plinth: Shredded ABS plastic made from discarded plastic from e-waste. Courtesy of Renew IT

Custom plinths fabricated by UNSW Design Futures Lab made with cold-pressed recycled plastic.

Green Metals

SMaRT's other Green Metals recycling processes involve extracting metals and alloys, including rare earth metals such as aluminium, copper, cobalt, and gold, from electronic wastes like computers, phones, batteries, and photovoltaics. Electronic waste (e-waste) and batteries contribute to one of the fastest-growing domestic waste streams, according to the *United Nations Global E-waste Monitor* 2020 report. There are concerns that the amount of electronic devices piling up in landfills could soon rival the current crisis presented by plastic waste. A shift in mindset towards the short life-cycle of electronic devices and their intrinsic material value is needed. Discarding e-waste ignores the high value of the materials it contains.

Electronic devices and batteries are composed of a complex mix of plastics, glass, metals such as gold, silver, copper, lithium, and rare earth minerals. Manufacturing these products requires the extraction of raw minerals from the earth, followed by an extensive and energy-intensive process of refining, production, and assembly. At the end of their life, these multi-material products present both a challenge and an opportunity. Although separating the components is difficult, e-waste contains high-demand metals that, once recovered, can be reused without the significant environmental impact of extracting virgin resources.

In 2018, the UNSW SMaRT Centre launched the world's first E-waste MICROfactorie™ with support from the Australian Research Council. Using specialised thermal techniques, the E-Waste MICROfactorie™ module can recover and reform metals from e-waste. For example, computer circuit boards can be transformed into alloys such as copper and tin. This technology is particularly important because there is no effective, widespread recycling method available for this challenging waste stream.

The work towards unlocking the potential of e-waste continues with the ARC Research Hub for Microrecycling of Battery and Consumer Waste. Commencing in 2021, this five-year national program led by SMaRT aims to establish viable means to recover 'lost resources' while transforming the waste industry by equipping it with advanced, small-scale, and localised manufacturing capabilities with real economic potential. For example, the lithium lost from discarded batteries could constitute a future (2036) economic loss to the Australian economy of between $813 million and $3 billion, based on 2019 commodity prices. SMaRT is partnering with various businesses and organisations to develop microrecycling technologies for pilot testing ahead of industrial application.

The potential of recycled Green Metals offers environmental, social, and economic benefits. To meet the demands of the growing renewable energy industries and to better manage the already mined resources, we must harness the valuable materials contained in waste.

E-waste & batteries

E-waste presents a unique challenge to recycling efforts. Electronic devices and batteries contain a complex mixture of plastics, glass, metals, and hazardous chemicals such as lead, cadmium, mercury, and persistent organic pollutants (POPs). Disassembling these items without proper safety equipment and procedures can lead to serious health problems for workers. If improperly disposed of in a landfill, e-waste and batteries can release toxic substances into the environment, causing significant contamination.

Despite these challenges, e-waste and batteries contain a host of high-demand materials, including gold, silver, copper, lithium, zinc, nickel, and rare earth minerals. While these materials are difficult to extract from e-waste, there is real potential for this waste stream to become a valuable renewable resource.

The Australian Department of Climate Change, Energy, the Environment and Water (DCCEEW) reported that Australians generated 511,000 tonnes of e-waste in 2019. This equates to 20kg of e-waste per person, markedly higher than the global average of 7kg per person. With high waste generation and low recycling rates, Australia faces a significant e-waste challenge. The development of innovative recycling and reforming technologies is crucial to minimising the human and environmental impacts of problematic electronic waste.

Image: Zinc Oxide synthesised from waste Zinc Carbon Batteries under high-resolution scanning electron microscopy (SEM). Credit: UNSW SMaRT Centre

Green Ceramics

Shoalhaven City Council, Kandui Technologies, and the UNSW SMaRT Centre have formed a partnership to establish a Green Ceramics™ MICROfactorie™ in the Shoalhaven region. This collaborative effort combines the council's waste management infrastructure, Kandui Technologies' commercial expertise, and SMaRT Centre's cutting-edge research to transform waste glass and textiles into valuable ceramic products.

Green Ceramics™ are a new generation of non-toxic ceramic products for use in buildings, furniture, and other applications. Traditional ceramics are made by shaping a mixture of clay and other materials into a desired form and hardening it through a firing process. While engineered stone products are now subject to health and safety regulations and bans due to silicosis disease, Green Ceramics™ are silicosis-free. The Green Ceramics™ MICROfactorie™ uses waste glass and textiles as the primary materials of the product. This technology combines pulverised glass with shredded textiles – which act as a bonding agent – in specific ratios using specialised

MICROfactorie™ equipment to create sustainable ceramic products from waste. This innovative system enables localised, on-demand production of materials and products. The Shoalhaven MICROfactorie™ represents a significant step towards a circular economy in the region, generating jobs and promoting environmental sustainability.

Kandui Technologies is the first licensee of SMaRT's MICROfactorie™ Green Ceramics™ Technology, and they operate several facilities, including the one located in the Shoalhaven Recycling Precinct. They play a critical role in bringing these materials to market and finding their applications in construction and building design through their brand Noveco Surfaces, where they distribute Green Ceramics™ products like benchtops, tiles, and furniture made from 90% recycled materials. The Shoalhaven facility anticipates processing approximately 450 tonnes of glass, mattresses, and other textiles annually into value-added materials for remanufacturing. As of 2024, it had manufactured 5,500kg of Green Ceramics™ products at its facility alone.

Display case contents

The Hon. Gabrielle Upton, Minister for the Environment of NSW, and Professor Veena Sahajwalla at the launch of the E-Waste MICROFactorie at Centre for Sustainable Materials Research and Technology (SMaRT Centre). 4 April 2018. Photographer: Quentin Jones. Credit: UNSW Archives. S2856/814

"World-first e-waste microfactory offers mobile solution to landfill," *UNSW Magazine*, no. 1, 2018, page 5.
Credit: UNSW Archives. S328.

Computer Motherboard.
Computer Central Processing Unit (CPU) chip.
Computer memory (RAM) chip.
Computer Hard Disk Drive.
Linear Tape Open (LTO) cartridge, magnetic tape storage media.
Discarded mobile phones, circa 2000 to 2015.
These items show the complex combination of plastic, metal, and other critical materials contained within e-waste.
Credit: UNSW SMaRT Centre

Disassembled lithium-ion battery cell showing layers of varying metal sheets (electrolyte removed).
Nickel-metal hydride (NiMH) batteries, commonly known as AA batteries.
Disassembled domestic lithium-ion battery, showing plastic casing, circuit board, and battery cells.
Jar: Nickel-metal cathode (Nickel hydroxide), parts removed from NiMH batteries.
Jar: Nickel-metal anode (Nickel-Cobalt-Rare Earth Elements), parts removed from NiMH batteries.
Jar: Nickel Cobalt (Ni-Co) droplets, extracted from lithium-ion batteries as part of the Green Metals process.
Jar: Cobalt-Nickel based superalloy produced from the combination of lithium ion, NiMH and Zn alkaline battery.
Jar: Rare earth elements salt, extracted from NiMH batteries as part of the Green Metals process.
Credit: UNSW SMaRT Centre

Glass

Glassmaking is an ancient craft dating back thousands of years. Glass manufacturing begins by melting a mixture of silica sand, soda ash, and limestone at extremely high temperatures until it becomes molten. This molten glass is then shaped using various methods, such as blowing or pressing, before undergoing a controlled cooling process called annealing, which removes internal stresses and strengthens the final product. Silica sand, also known as quartz sand, is found in large deposits in Australia, where it is mined for domestic use and international export. Once silica is manufactured into glass, it can be repeatedly recycled, which requires less energy than making glass from raw materials. Despite this, glass still ends up in landfills, where it does not decompose but gradually breaks down into small fragments. By utilising glass often considered too contaminated or complex for traditional recycling methods in their Green Ceramics™ technology, UNSW SMaRT Centre converts this waste material into a usable form for remanufacturing.

Image: Glass powder under high-resolution scanning electron microscopy (SEM). Credit: UNSW SMaRT Centre

UNSW
SYDNEY

Display case contents

“The Year we Choose our Future,” *UNSW Magazine*, no. 2, 2019, pages 12-13. Credit: UNSW Archives. S328.

Green Ceramics™ tiles composed of approximately 80% glass and 20% other materials, including recycled face masks, ghost nets, and textiles. Credit: UNSW SMaRT Centre

Wall-mounted tiles: Green Ceramics™ tiles made with various materials. From left to right:
denim
ghost nets
coffee
school uniforms
face masks
mattress flocking

Credit: UNSW SMaRT Centre

3D printed display mounts designed by UNSW Library and made by UNSW SMaRT Centre using recycled e-waste filament supplied by Renew IT.

Object: Memorial gravestone and urn, ‘End Cycle’, waste glass / waste textile from deceased person / NFC chip, designed by GibsonKarlo in collaboration with Professor Veena Sahajwalla, SMaRT Centre at the University of NSW, Sydney, New South Wales, Australia, 2020
Credit: Powerhouse collection, Purchased 2020

Video: *Green Ceramics™ tiles made with coffee waste*
Silent single-channel video, 1:29 minutes
Credit: Footage supplied by UNSW SMaRT Centre, edited by UNSW Library

Green Ceramics™ tiles made with textile waste
Silent single-channel video, 2:08 minutes
Credit: Footage supplied by UNSW SMaRT Centre, edited by UNSW Library

Object: Bench made with Green Ceramics™ tiles
Credit: UNSW SMaRT Centre

We invite you to sit on the bench.
Please do not touch the other objects in the exhibition.

Textiles

Textile manufacturing has evolved from traditional handcrafts to modern industrial processes, beginning with the use of natural fibres like cotton and wool. Textiles are made by spinning these fibres into yarn before weaving or knitting them into fabric. During the Industrial Revolution, these processes were automated through innovations like the spinning jenny and power loom, leading to mass production and global trade. Fast fashion represents a dramatic acceleration of textile manufacturing processes to produce and distribute massive quantities of clothing at unprecedented speeds and low costs. The fast fashion business model prioritises this speed and volume over quality and sustainability, leading to significant environmental concerns and waste. Although second-hand clothing shops can help divert used clothing from entering landfills, Australians are among the highest consumers of textiles per capita globally. The growing volume of waste textiles requires additional solutions like UNSW SMaRT Centre's Green Ceramics™ technology.

Image: Textiles under high-resolution scanning electron microscopy (SEM). Credit: UNSW SMaRT Centre

Object on plinth: Various textiles manufactured into clothing, including natural fibres like cotton and synthetic materials like polyester. Credit: UNSW Library

Custom plinths fabricated by UNSW Design Futures Lab made with cold-pressed recycled plastic.

UNSW Library
Special Collections and Exhibitions

Curator
Dr Megan R. Fizell

Exhibitions Coordinator
Dr Emily Morandini

Special Collections & Experiential Learning Coordinator
Brook Morgan

Visual Communications & Publications Coordinator
Jane Eliasson

UNSW SYDNEY