

Physical Sciences Innovation Pipeline | February 2022

Program name	Description	TRL 1 - 3	TRL 4 - 5	TRL 6 - 7	TRL 8 - 9
Formulation technologies					
Pesticide formulation technology	Silica carrier particles that encapsulate active ingredients (AI) to provide UV protection, increased rainfastness and easier formulation of hydrophobic AI	●	●		
Engineered nano-clay for agriculture applications	Novel nano-clay technology with enhanced cation exchange capacity and efficient loading of agricultural actives	●	●		
Nanocapsules	Encapsulated emulsion droplets for sustained or burst release of active ingredients, including microbes	●	●		
Controlled release nano-termiticide formulation	Nano-formulation technology with high loading capacity of nano-dispersed active ingredient that can be designed to precisely control the release rate and enhance the soil penetration of the active ingredient	●			
Advanced adjuvants for vaccine applications	Surface modification of silica-based nanoadjuvants provokes enhanced cell mediated innate immunity, cellular and humoral immune responses	●			
Unmanned aerial vehicles (UAVs) and robotics					
Bipedal robot	A low cost gyroscopically stabilised bipedal robot	●			
Y4	A more efficient quadrotor unmanned aerial vehicle (UAV) design with longer duration suitable for industrial applications	●	●	●	
Safety rotor	A lightweight safety feature for minimising blade impact in unmanned aerial vehicle (UAV) operation	●	●	●	
Sensors, devices and optoelectronics					
Force sensing device (Sports)	Novel method of detecting force and torque for various applications	●	●	●	
Passive on-chip microwave circulator	A passive, on chip, superconducting microwave circulator with high bandwidth (~500 MHz), for use in mobile communications and quantum computing	●			
Organic laser materials	Electrically pumped organic semiconductor lasers based upon novel optical cavities and organic semiconductors. Applications in flexible, flat screen displays, sensors, spectroscopy and telecommunications	●			
Light emitting field effect transistors	An organic light-emitting field-effect transistor containing a delayed fluorescent material, excitons can be efficiently used for light emission to remarkably enhance the emission efficiency of the transistor and high mobility along with high on/off ratios	●			
Force sensing device (UAVs, Robotics, Aerospace, Defence)	Novel method of detecting force and torque for various applications	●	●	●	
Quantum technology for terahertz imaging and sensing	High-performance terahertz laser feedback interferometric imaging and sensing	●	●		
Ultra high sensitivity magnetometer	Ultrasensitive chip-sized detection of magnetic fields at room temperatures	●			
Quantum dots (QD) for display applications	Process for synthesising highly stable QDs with efficient light emission demonstrated in deep red and near infrared (process can also be applied to green and blue QDs)	●			
Nano-phononic circuit platform	Nano-mechanical computation and sensing platform that is robust to radiation	●			
Perovskite composite material	New class of composite material which enhances the optical properties and stability of perovskites	●			
Microwave inspection system	Microwave inspection technology with automated scanning for multiple surfaces	●			
Big data solutions, analytics and communications					
Advanced mobility analytics	Video analytics technology which focuses on changing the paradigm of current traffic safety management practice by proactively identifying and diagnosing safety issues before they occur using artificial intelligence (AI) and advanced econometrics. Packaged as SaaS	●	●	●	
Automated Topology Builder (ATB)	Accurate force field parameters for molecular modelling and molecular dynamics	●	●	●	
Orthogonal precoding for sidelobe spectrum suppression	A novel method for increased spectral efficiency in communication systems. Out of band power suppression using blocking reflectors in the allocated spectrum for enhanced gain. Potential use in 5G and 6G	●	●		
Quantum link verification	This technology ensures trust in the structural integrity of a physical link between two nodes in a communication network, for example, servers in a data centre or nodes of a secure line connection	●			
Water and environmental					
Sewex	Algorithm-based software for H2S, corrosion reduction and sewer network modelling. Potential for SaaS redevelopment. Commercial projects Australia-wide and globally	●	●	●	●
Lodomat	An advanced system for wastewater treatment of sludge utilising anaerobic digestion, free nitrous acid (FNA) to inactivate nitrite oxidising bacteria (NOB), partial nitrification using NOB to remove nitrogen followed by Anammox process and altering ammonium to alkalinity ratio	●	●		
Alkaline digestion of waste glass	A simple process developed for the extraction of sodium silicate from soda-lime glass, characterised by a high utilisation of the raw material and energy embodied in glass	●	●		
Computer vision system	Algorithm based software for monitoring water flow	●			
Gold recovery from e-waste	Recovering gold and other metals from e-waste using low capex/opex hydrometallurgical process	●			
PFAS	Innovative technologies to investigate and remediate PFAS (per- and poly-fluoroalkyl substances) contaminated media including soil and other solid contaminated debris, groundwater, waterways and marine	●			
Dewatering process for wastewater sludge	Use of pulsed power and ultrasound for dewatering wastewater organic sludge	●			

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Advanced materials					
Graphene processing strategy for improved battery cathodes	Processed graphene as cathode in Aluminium-ion battery shows high specific discharge capacity and excellent reversibility	●	●	●	
Nanocomposite elastomers	Strong, tough, yet low modulus elastomers enabled by reinforcement with flexible, tough nanofibers of cellulose	●	●	●	
Nanocellulose	High aspect ratio, extremely tough nanofibers of cellulose for reinforcement, paper, cement, geopolymers, adhesives, eco-packaging and other applications	●	●	●	
PHA biopolymer composites	Biodegradable PHA bioplastics, biocomposites and bio-products	●	●		
Ultra-bright, low power QD displays and lighting	Significantly improve the ability of quantum dots (QDs) to capture incident light and produce a brighter fluorescence emission	●	●		
Efficient production of cyclic proteins	Protocol for synthesising circularised proteins that is low-cost and high-yield	●	●		
Alloys for 3D printing	High strength and high ductility Ti and Cu alloys with inexpensive nanoparticles using innovative chemistry	●			
Carbon fibre conversion from PVC	Method for forming higher strength/lower weight carbon fibre from contaminated waste and virgin polyvinylchloride (PVC)	●			
Mining and energy innovation					
Producing zeolite from mining tailings	A novel technology to use waste and mining tailings to produce high value zeolite	●	●		
Borehole condition monitoring sensor	Low-cost, disposable sensor probe for automatic depth detection in boreholes to improve outcomes in drill and blast operations	●	●		
Solid oxide fuel/electrolysis cells	A solid oxide fuel cell designed with enhanced thermal management providing enhanced longevity	●	●		
Froth deaeration system	A deaerator apparatus that has been demonstrated to achieve significant air reduction of coal froth	●	●		
Solar F2D2 - solar farm fault detection & diagnosis	An algorithmic system that has automatic fault detection, performance monitoring and predictive modelling for solar farm photovoltaic (PV) panels	●	●		
Froth flotation measuring sensor	An <i>in-situ</i> device to accurately measure frother concentration in a flotation cell to increase efficiency, yield and revenue of a mining process	●	●		
Record efficiency quantum dot (QD) solar cell	Breakthrough on low-cost emerging generation QD solar cells that achieve a verified world record efficiency of 16.6%	●	●		
Technologies for improving mineral recovery during flotation	Processes, operating conditions, selective reagents and devices for improving the recovery of valuable minerals from flotation	●	●		
Sustainable and eco-friendly remediation of bauxite residue	Sustainable bio-remediation of alkaline bauxite residues via microbial pH neutralisation	●			
Flotation stability improvement system	An <i>in-situ</i> device to improve stability of froth in the mineral flotation process, using specific sound waves	●			
High voltage pulse power separation system	Integrated separator system and process for preconcentration of materials using high voltage pulse power	●			
Dewatering process for mining tailings	High frequency/low voltage pulse power dewatering process for mining tailings such as copper, coal and red mud	●			
Enzymatic metal processing	Processing of low grade ore to recover valuable metals using an enzyme-driven bioleaching step	●			
Supercritical CO ₂ turbine	Highly efficient small-scale (up to 30 MW) powerblock for integration with a wide range of distributed energy generation technology and also waste process heat recovery	●			
Removal of radioactive contamination in mining	Efficient process for the removal or reduction of radionuclide contamination in a wide range of complex ore bodies and tailings, including those containing lithium, rare earth elements and copper	●			
New approach to copper production	On-mine site environmentally friendly copper production, avoiding high temperature smelting process	●			
Bayer process improvement	Cost reduction for alumina production through reduced caustic soda consumption	●			
Improved off-the-road wheels	Safer wheels for pneumatic tyres for off-road earth moving and mining vehicles	●			
Medical technologies					
Ultra-low field MRI	Low magnetic field strength enables the instrument to be used at the bedside, unlike conventional MRI scanners	●	●		
Psychomotor Vigilance Task (PVT) test alternative	A novel method for assessing neuropsychological impairment using electroencephalogram (EEG)	●	●		
Sleep apnea assessment	At-home screening and/or diagnosis of sleep apnea using snore sounds captured on a mobile phone	●	●		
High sensitivity immunoassays	Nanotechnology-enabled amplification of signals in immunoassay to lower limits of detection	●	●		
RF coil-element for UHF MRI	RF coil-element designed to have low sensitivity to loading changes, superior inter-element isolation, and better efficiency regarding RF energy deposition	●	●		

● Partnered ● Asset available for partnering

Technology Readiness Levels (TRLs)

- TRL 1 Basic principles observed
- TRL 2 Technology concept formulated
- TRL 3 Experimental proof-of concept
- TRL 4 Technology validated in lab
- TRL 5 Technology validated in relevant environment

- TRL 6 Technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 7 System prototype demonstration in operational environment
- TRL 8 System complete and qualified
- TRL 9 Actual system proven in operational environment - competitive manufacturing in the case of key enabling technologies; or in space