

Physical Sciences Innovation Pipeline | October 2019

Project name	Description	TRL 1 - 3	TRL 4 - 5	TRL 6 - 7	TRL 8 - 9
Formulation technologies					
Crop protection	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	●	●		
UAVs and robotics					
Y4	A more efficient quadrotor UAV design with longer duration suitable for industrial applications	●	●	●	
Safety rotor	A lightweight safety feature for minimizing blade impact in UAV operation	●	●	●	
Novel LIDAR	A novel multi pixel solid state LIDAR (Light Detection and Ranging)	●	●		
Biped	A low cost gyroscopically stabilised biped	●			
Sensors, devices and optoelectronics					
Force sensor	Novel method of detecting force and torque for various applications including UAV, robotics and sports	●	●	●	
Self-mixing terahertz laser	A novel sensing and imaging technology in the terahertz spectrum	●	●		
Ultra High Sensitivity Magnetometer	Ultrasensitive chip-sized detection of magnetic fields; applicable in other sectors too	●			
Microwave circulator	A passive, on chip, superconducting microwave circulator with high bandwidth (~500 MHz), for use in mobile communications and quantum computing	●			
Light emitting field effect transistors	An organic light-emitting field-effect transistor containing a delayed fluorescent material, excitons can be used for light emission to enhance the emission efficiency of the transistor and high mobility along with high on/off ratios	●			
Organic lasing materials	Electrically pumped organic semiconductor lasers based upon novel optical cavities and organic semiconductors. Applications in flexible, flat screen displays, sensors, spectroscopy and telecommunications	●			
Automated microwave inspection system	Microwave / millimetre wave inspection technology assisted by automated (robotic) scanning for hyperloop-type transportation systems	●			
New class of colloidal QD for optoelectronics	Process for synthesising highly stable QDs with efficient light emission demonstrated in deep red and near IR (process can also be applied to green and blue QDs)	●			
Big data solutions - health, telecommunications					
Digital pathology	The first stand-alone, ultra-fast, fully automated, microscope-free, fully certified analysis and diagnostic platform for pathology slides	●	●	●	●
Spectral enhancement - orthogonal precoding for sidelobe 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	●	●		
Blockchain health	A new method of managing health data with focus on privacy preserving and data ownership	●			
Water and environmental					
SeweX	Algorithm based software for H2S, corrosion reduction and sewer network modelling. Potential for SaaS redevelopment. Commercial projects all over Australia and internationally	●	●	●	●
Lodomat	For use in wastewater treatment plants: a novel process for increasing biogas production and reducing sludge disposal costs from anaerobic digestion, reducing the cost of nitrogen removal and improving the efficiency of the anammox process	●	●		
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	●	●		
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	●			
E-waste recycling	Recovering gold and other metals from e-waste using low capex/opex hydrometallurgical process	●			

Technology Readiness Levels (TRLs)

- TRL 1** Basic principles observed and reported
- TRL 2** Technology concept and/or application formulated
- TRL 3** Analytical and experimental critical function and/or characteristic proof-of concept
- TRL 4** Component/subsystem validation in laboratory environment
- TRL 5** System/subsystem/component validation in relevant environment
- TRL 6** System/subsystem model or prototyping demonstration in a relevant end-to-end environment
- TRL 7** System prototyping demonstration in an operational environment
- TRL 8** Actual system completed and "mission qualified" through test and demonstration in an operational environment
- TRL 9** Actual system "mission proven" through successful mission operations

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Advanced materials					
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, concrete and other applications	●	●	●	
Membrane Crystalliser	Continuous crystallisation to produce high quality solid crystal product from solution in a single step	●	●		
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	●	●		
Carbon matrix composites	A composite material which can be used as a fire resistant or fire retardant polymer. When pyrolyzed, the material produces a high strength of carbon-carbon composite for use in high temperature applications such as brake components for F1 cars, nose cones and flight surfaces of supersonic and hypersonic vehicles and heat exchangers	●			
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					
Frother measuring system	An in-situ device to accurately measure frother concentration in a flotation cell to increase efficiency, yield and revenue of a mining process	●	●		
Photorechargeable battery	Integrated photo-rechargeable battery with a high photovoltaic conversion/storage efficiency of 11%, and remarkable rate-capacity and cycling stability	●	●		
Record efficiency QD solar cell	Breakthrough on low-cost emerging generation quantum dot solar cells that achieve a verified world record efficiency of 16.6%	●	●		
Producing Zeolite from Mining Tailings	A novel technology to use waste and mining tailings to produce high value Zeolite	●	●		
Solar F2D2- Solar Farm Fault Detection & Diagnosis	Fault detection and location algorithm for photovoltaic (PV) systems including large solar farms	●	●		
Flotation stability improvement system	An in-situ device to improve stability of froth in mineral flotation process, using specific sound waves	●			
Optimised Blast / Drill Hole Location System	An algorithm to indicate the best next blast/drill hole to optimise operation and reduce cost of blast and operation	●			
High Voltage Pulse Power Separation System	Integrated separator system & process for preconcentration of materials using high voltage pulse power	●			
Dewatering Process for Mining Tailings	High voltage / low frequency 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	●			
Medical technologies					
Psychomotor Vigilance Task (PVT) test alternative	A novel method for assessing neuropsychological impairment using EEG (electroencephalogram)	●	●		
Sleep state determination using EEG	A novel method for determining sleep stages using EEG (electroencephalogram)	●	●		
High sensitivity immunoassays	Nanotechnology-enabled amplification of signals in immunoassay to lower limits of detection.	●			
Structural PET imaging using Quantum Entanglement	We have developed a method of using Compton cameras to pinpoint the scattering sites when entangled gamma ray photons are involved, which can lead to the visualisation of structural information Nanocomposite Elastomers s	●			
Ultra-low field MRI	Low magnetic field strength enables the instrument to be used at the bedside, unlike conventional MRI scanners that require specially constructed operating environments for patient and staff safety because of the risks posed by high magnetic field	●			
Space technologies					
Hypersonix	A 3 stage launch vehicle for launching small (~100kg) satellites into Low Earth Orbit. The first stage flies back to base using a deployable aeronautical system. The second stage uses a reusable scram jet vehicle and the third stage is a conventional single use rocket.	●			