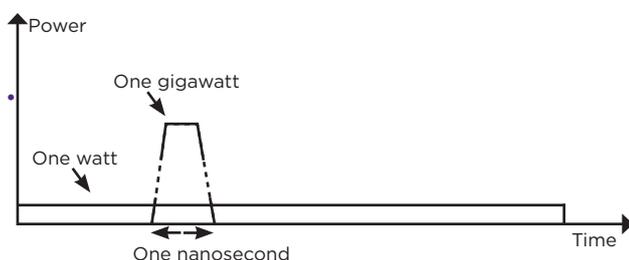


# International Pulsed Power Workshop

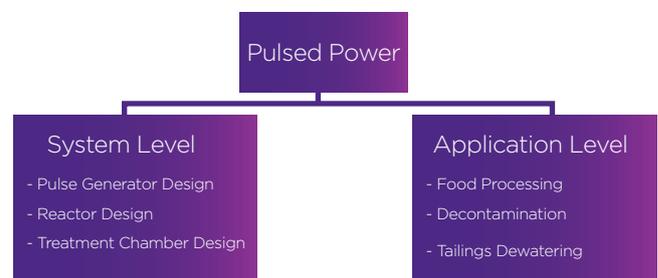
**Nanosecond Pulsed Power System - An Emerging Multidisciplinary Technology for Industrial and Bioelectrics Applications**

## What is “Pulsed Power”?

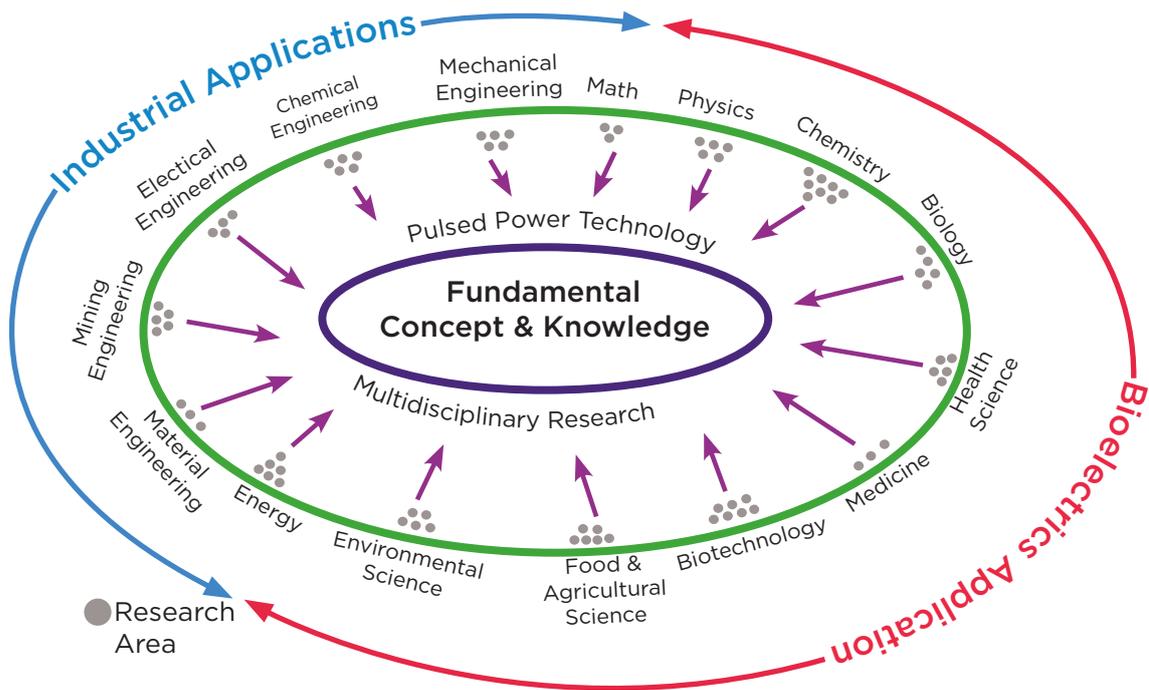
Pulsed Power Technology refers to generating high voltage pulses with narrow pulse width to deliver a huge amount of energy over a short period of time. In the pulsed power system, the released energy is usually in the form of high-power in a short time. Although the peak power of the generated pulse is very high, around a few GW, but the average power is very low.



Pulsed power is an exciting, emerging technology, and this state-of-the-art facility will enable Australian researchers to explore nanosecond pulsed power excitation in a variety of industrial and bioelectrics applications, including water treatment, mining, food processing and bio-energy. The ability of pulsed power to deliver energy as pulsed electromagnetic waves, plasmas, shock waves, radicals and light, opens up new research challenges and unexplored opportunities for applications in industry. The proposal also provides an opportunity to link several individual areas of Australian science and engineering in new collaborative research.

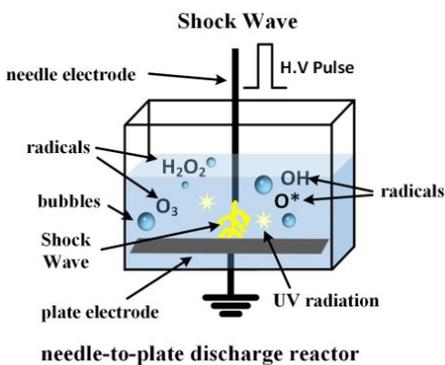


# Pulsed Power is a Multi-disciplinary Research Field

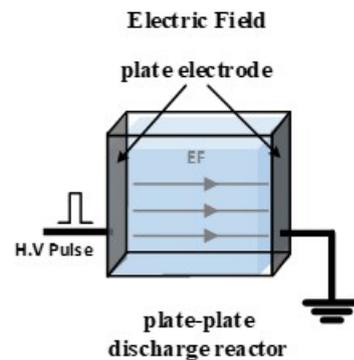


## Pulsed Power Phenomena

When the generated pulses are applied to liquid and gas samples, plasma is produced. Two different types of plasma are usually generated, thermal and non-thermal plasma. The non-thermal plasma is based on chemical and physical reactions and results in biological effects and production of some biocidal agents such as electric fields (EFs), reactive chemical species, ultraviolet radiation (UV), heat and shock waves. Several reactive species like OH radicals, ozone, and hydrogen peroxide can be formed in gas-liquid phases in a treatment system when plasma discharges are applied.

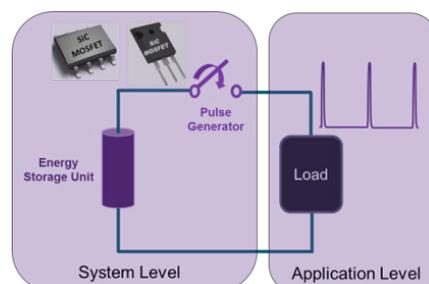


for industrial and bioelectric applications such as food pasteurization and medical electroporation treatments



## Pulse generator Design

Compared to spark gap or photoconductive switches used in conventional nanosecond high voltage pulse generators, wide bandgap power semiconductor devices are used to generate the required high voltage pulses through power converters with minimal losses and size of the pulse generators.



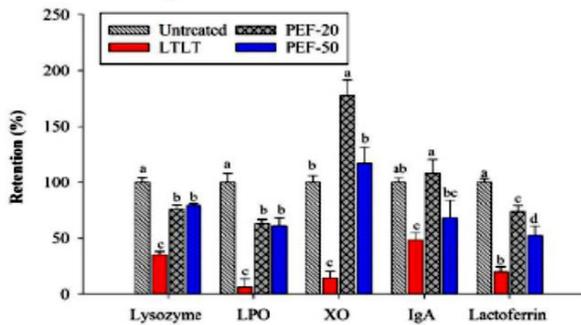
With the plasma discharges generated in the liquid phase, physical processes like EFs, shock waves and UV highly contribute to the biocidal process in addition to chemical effects. The high oxidizing properties of these reactive species make them potential candidates for facilitating the treatment processes.

The EFs are generated when high voltage pulses with short duration are applied across two electrodes placed on both sides of the sample. The pulsed EF showed great potential to be applied as an effective method

## Pulsed Power Applications

### Milk Treatment

Pulsed power system can be designed and developed for milk treatment. As compared to other proposed pasteurization methods, using pulsed power technology not only results in the milk decontamination but also retains milk's bioactive compounds unaffected.



Bioactive compound retention in human milk after heat (LTLT) and nsPEF processing

### Mineral Tailings Dewatering System

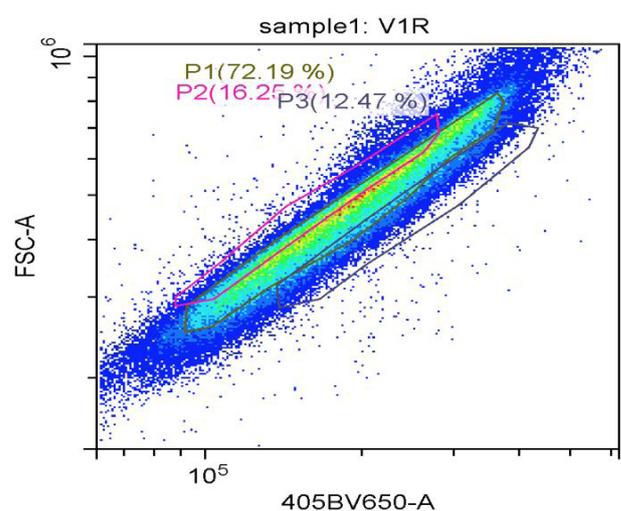
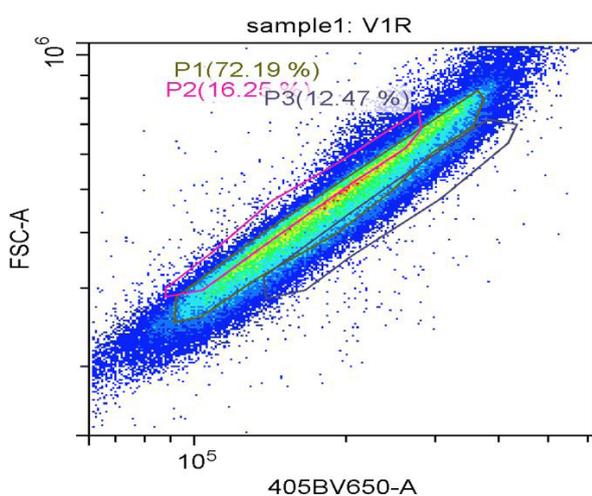
Separating water from mineral tailings is one of the challenging issues in mining industry. High frequency non-destructive electrical excitation can stimulate a soft object such as slime and can separate water from the object. A high frequency low power and low voltage signal was generated to stimulate the slime sample placed between two electrodes. The results proved the effectiveness of the pulsed power technology in separating water from the slime sample where the runny water was collected from the surface of the sample.

### Microalgae Cell Breaking Process

Nanosecond pulse electric field as a physical method showed a great potential in hydrocarbon extraction from microalgae. Preliminary studies showed that nsPEF stimulation led to an increase in the number of broken cells in microalgal cultures, confirming its viability as a harvesting-related process in commercial applications.

### Water Treatment

Escherichia coli (E.coli) is one of the harmful bacteria to human body that can cause serious illnesses. This bacteria is widely found in wastewater. Pulsed Electric Field (PEF) technology can effectively degrade E.coli bacteria in the water. The experimental results showed a significant reduction in E.coli bacteria in the contaminated water sample.



Microalgae Cell Breaking

**Food Processing  
Group, UQ**

Dr Nidhi Bansal

**Algae Group, UQ**

Prof. Peer Schenk

**Sustainable Minerals  
Institute, UQ**

A/Prof Mansour Edraki

**Pulsed Power  
Research Group, UQ**

Prof. Firuz Zare  
Dr Negareh Ghasemi

**Advanced Water  
management Centre,**

Dr Shihu Hu

**Chemical Engineering  
Group, UQ**

Prof. Vector Rudolph

**International  
Collaborator**

Kumamoto University,  
Japan

**For further details, please contact:**

Prof. Firuz Zare  
T +61 7 3346 9181  
E f.zare@uq.edu.au

Dr Negareh Ghasemi  
T +61 7 3365 4675  
E n.ghasemi@uq.edu.au



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OF QUEENSLAND**  
AUSTRALIA

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