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# Industrial Member Report Summary – Key Findings for Industry

## Characterisation of a Novel Electron Beam Gun Design with a Radio Frequency Excited Plasma Cathode

TWI Core Research Programme

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## Industrial need

Most material processing by electron beams (EB), such as welding, melting and 3D printing, uses a thermionic triode electron gun design. There are a number of problems that can occur with this type of gun, and these can interrupt processing or cause variations in welding or manufacturing performance. The cathode can distort or wear, and slowly erodes through evaporation, causing variation in welding or manufacturing performance. The bias potential used to control beam current can electrically break down to the cathode, which can result in a surge in beam current and interruption to the process.

## Key Findings

An RF excited plasma cathode EB gun is presented in this work that offers the potential to provide reliable and consistent beam processing. The use of RF simplifies the power supply and enables rapid beam pulsing

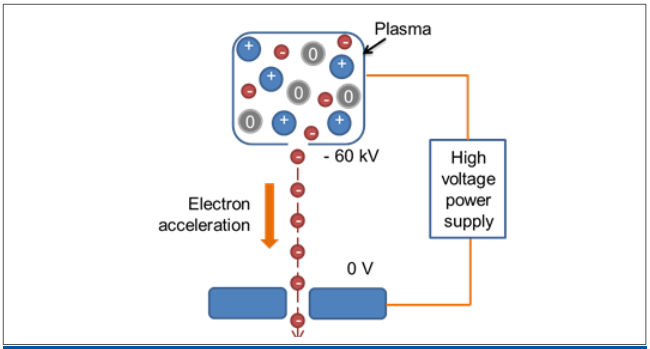


Diagram showing an electron beam extracted from a plasma

- An electron beam has been drawn from a plasma cathode produced with low pressure gas and RF excitation
- The maximum power generated from the design to date is 3.2kW, at -60kV accelerating potential.
- Beam switching times of less than 1µsec have been measured.
- Optical emission spectroscopy has been used to derive the characteristics of the plasma such as electron temperature and relative electron density.

## How to benefit from this work:

- As an Industrial Member of TWI, you have free access to the full report
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