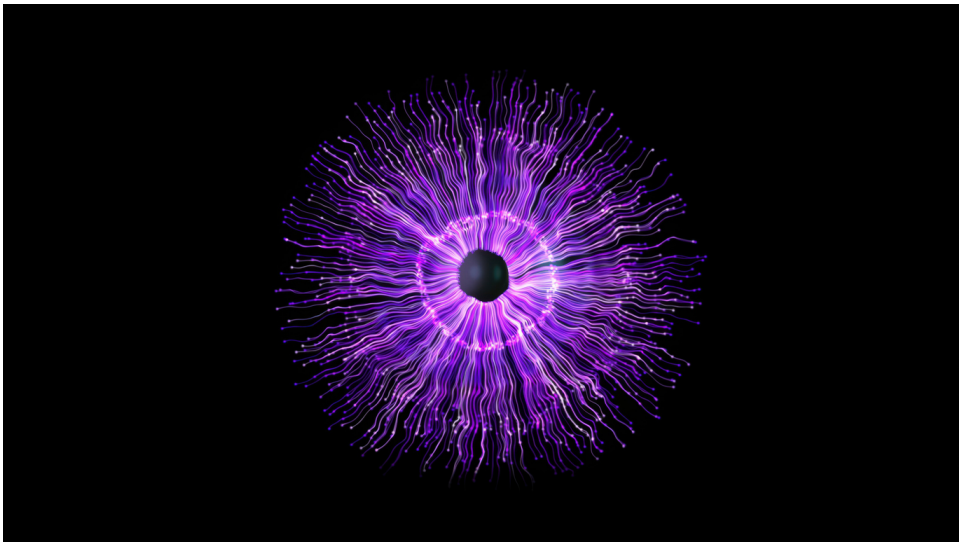
Atmospheric Pressure Plasma Discharge Monitoring & Control Method

Category
Hardware

Non-invasively monitoring plasma discharge parameters to serve either as a process control technique or a surface characterisation method



iStock image: UniqueMotionGraphics

Background

Atmospheric plasma discharges methods have wide industrial use. Unfortunately they can be difficult to control. This lack of control often results in a decision to limit the power delivered by the electrical plasma generator system reducing intensity to prevent the formation of arcs or surface damage due to excess power. Unfortunately this risks process failures when too low discharge intensity is used. This invention provides a method of resolving this problem offering the ability to control the plasma discharge for improved quality and opening up new applications.

Alternatively, in a different mode of operation, the invention allows the use of plasma systems to characterise the surface of materials and bulk material integrity.

Technology Overview

The technique involves using a near-field antenna, or a similar method capable of capturing the electrical discharge waveform. In its simplest use, a length of wire placed in vicinity of the plasma can serve as a suitable pick-up method. For AC powered plasmas, the captured signal is buffered and filtered to remove high power signals present. The resulting signal is fed into a device capable of frequency domain analysis. As a low-cost, small size solution, a software-defined radio receiver can be used alongside a single board computer to capture and process the resulting signals.

Signal analysis relies on generation of spurious harmonics and radio frequency emissions in the plasma plume. For pulsed, radio frequency plasmas, relative intensity these plasma emissions are used to generate an error signal that can be fed into a control loop in situ (PID control or similar) to keep the plasma dissipated power stable under changing environmental conditions. For surface characterisation, this error signal can be recorded as a function of time or spatial position to provide a map of the surface impedance. The technique is very sensitive to small changes in surface impedance at higher frequencies, capable of detecting the presence of conductive inclusions or non-uniform sections that may be present underneath a plasma exposed surface. The spatial resolution in this case is limited by the size of the plasma plume, extending down to the micrometre range.

Benefits

Existing solutions are incapable of providing feedback during the plasma process. This technology has the following benefits:

• Provides instantaneous feedback on the discharge characteristics to maintain repeatability for the plasma treatment process.

• Provide information on the substrate characteristics, namely, conduction and surface properties.

• In conjunction with a plasma deposition technique, can be used to ensure that the deposited layers are uniform, or in the case of conductive material deposition, that the deposited sections are end-to-end conductive.

Applications

The commercial application is potentially twofold: as a process monitoring tool for atmospheric pressure plasma or as a dual use surface characterisation and discharge diagnostic tool for use in medical plasma tools or similar.

Opportunity

The invention will be of plasma equipment for integration into their products for a variety of applications including surface treatment for adhesion promotion or cleaning.

Patents

• UK priority application number 2200530.0

Seeking

Licensing, Seeking investment

IP Status

Patent application submitted