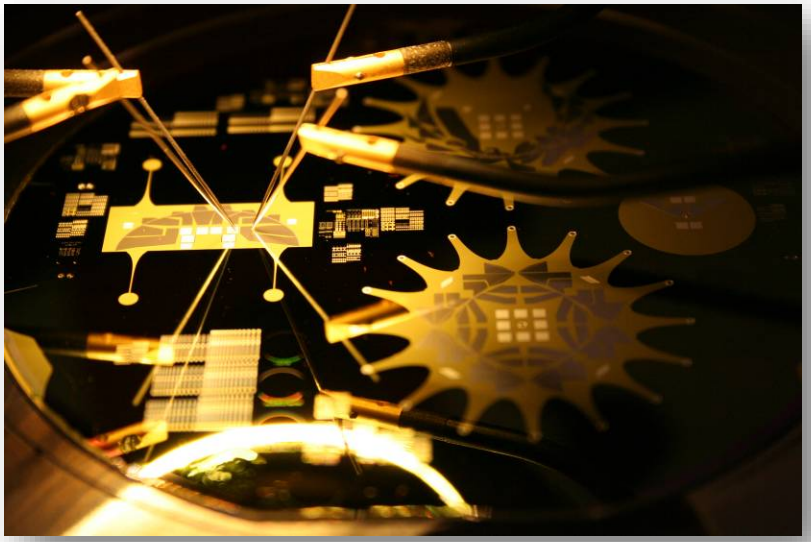
Plasma Antennas

PLASMA TECHNOLOGY



May 2017

Introduction

- Inventors of Plasma Silicon Technology

  - A truly new approach to beam forming and steering.

- Solution to 5G transmission problems

  - Low loss, high power handling (tested to 40 Watts CW)

- Changing the economics of all mmWave applications

  - Antenna and overall system simplification.

Plasma Antennas Limited is a UK smart antenna research, design and manufacturing company.

The company has built a strong client base designing and building defence and security antennas based on the principles of Plasma Silicon.

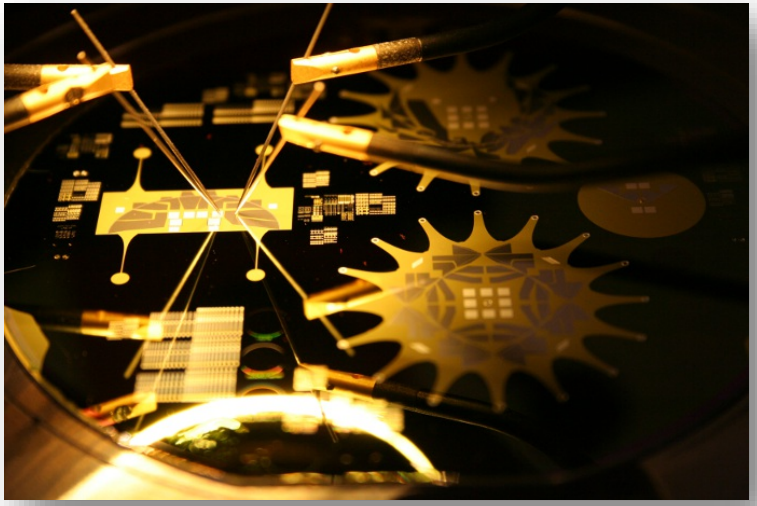
Plasma Silicon itself took more than a decade of research and development to complete. It has been independently verified for defence applications.

The company now wishes to exploit its technology for mmWave mass market applications such as 5G, WiGig, connected and autonomous vehicles, mobile devices, games consoles, wearable virtual and augmented reality tech.

Plasma Antennas

What is a (solid state) Plasma Antenna?

Based on a Plasma Silicon Device (PSiD)



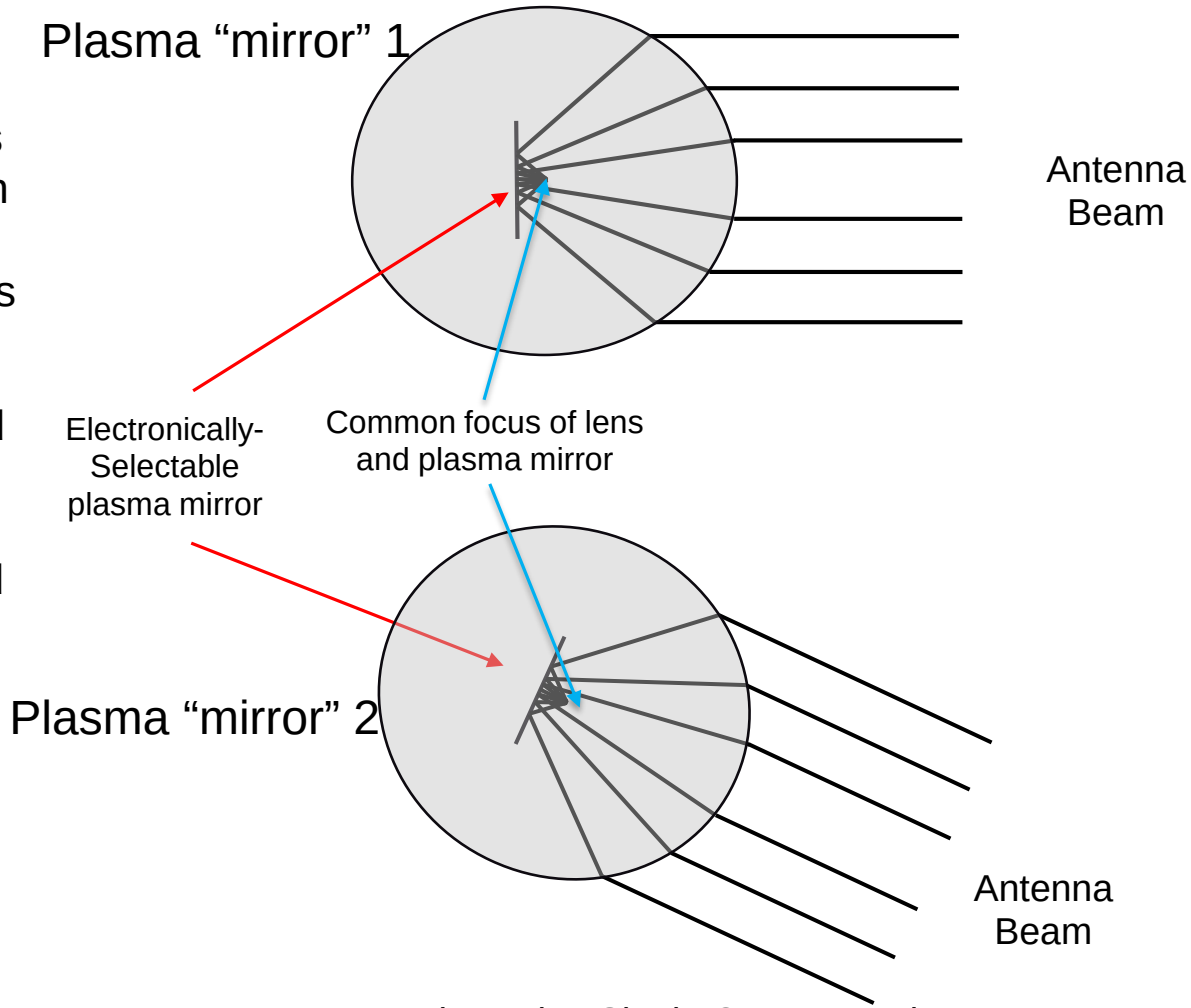
- Novel microwave-optic technology that exploits reflective properties of solid-state plasma created in array of PIN diodes
- Replaces high loss RF switches, phase shifters & attenuators with a single compact low-loss device

Technical capabilities and advantages:

- Able to electronically form and steer very high gain "pencil" beams at millimeter wave frequencies
- Adaptable beam shaping, including 360º Omni Mode
- High sensitivity due to low insertion loss
- High-speed fully electronic beam steering (<1us, 300ns specs in progress, sub 100ns expected)
- High power handling (tested to 40 Watts, 100 Watt defence applications proposed)
- Required precision achieved using standard silicon processes
- Compatible with standard RF substrates
- Low cost

How does it work?

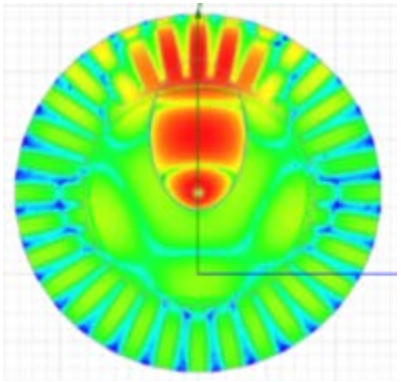
- A metalized silicon die acts as waveguide and as a thin circular lens to RF energy injected at focus & so forms an antenna beam
- An electronically generated plasma “mirror” re-directs RF energy to common central focal point and feed
- The plasma mirror can be electronically rotated (i.e. re-formed) to steer the beam



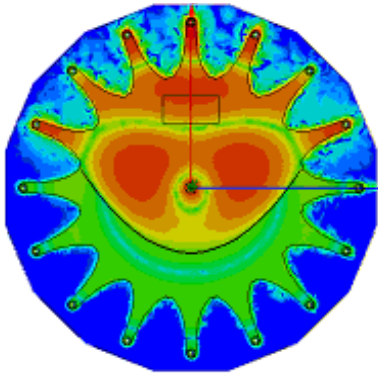
Beamsteering using Single Centre Feed and “Rotating” Plasma Reflector

PSiD Plasma Silicon Device Operation

PSiD suitable for a Planar Design



PSiD suitable for a Cylindrical Design



Additional details of PSiD operation:

- A plasma reflector is created by forward biasing a set of PIN diodes within two dimensional array
- In practice, the reflective surface is elliptical in shape
- The shape of reflector can be adjusted for different beam shapes (i.e. variable beam width)
- With the reflector “off” device acts omni-directionally
- RF can radiate directly from the edge of the PSiD silicon (i.e. through a horn or lens) – particularly suited to smaller antennas
- If the PSiD device is integrated onto an RF substrate, radiation can be through any conventional antenna type (e.g. patch array)
    - The PSiD device selects the desired active ports and applys both amplitude weights and time delays to those ports
    - Suited to larger antennas and/or non cylindrical designs

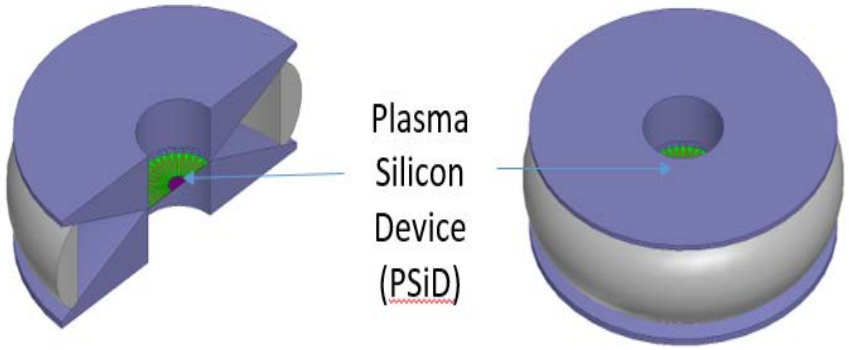
PSiD as an antenna

A typical 28GHz PSiD is 10mm diameter a typical 60GHz PSiD is 4mm diameter.

For low gain applications RF can be radiated directly from the chip via printed structures.

To deliver the required pattern and higher gain the die is typically mounted within a larger structure.

In this very simple example a metalized plastic “horn” to form a 360º single beam antenna.



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Configurations and applications

Example Configurations of PSiD's

Single 360º Field of View

Stacked 2D scanning in azimuth and elevation

Sectors, 60º, 120º, etc.

Reflector

Stacked multi beam 360º field of view

Single 2D scanning in azimuth and elevation

Planar or Cylindrical configurations

Other (Real Time Delay devices etc.)

Applications

5G small Cells 28GHz to 67GHz,

Point to Point and Point to Multi-Point

Sat Comms

5G and WiGig devices (tablets, phones, AR, VR)

Scanning Radar for Autonomous Vehicles (77GHz)

Defence and Security