UNIVERSITY OF BIRMINGHAM

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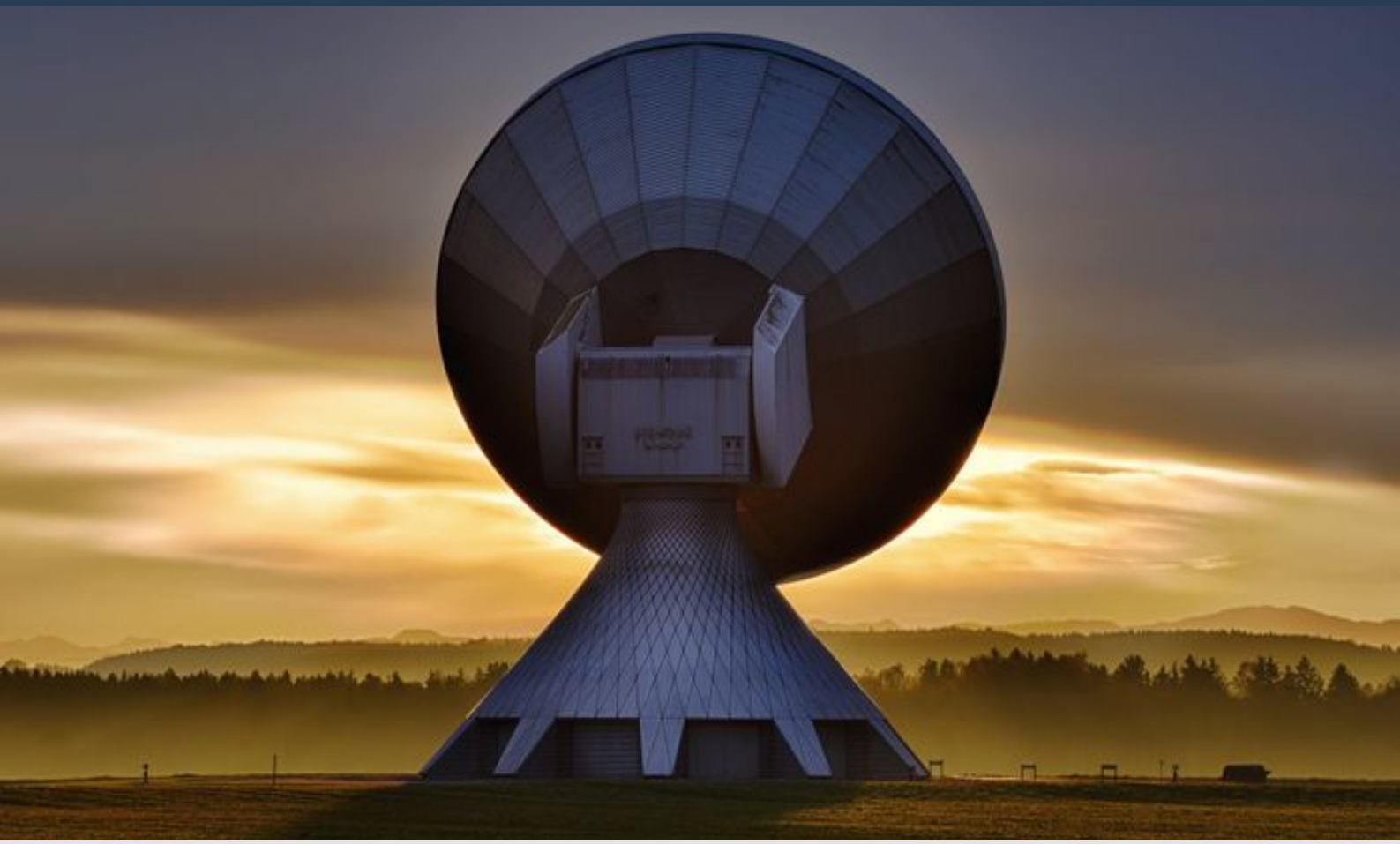
Microwave Passive Circuits Using 3D Printed Alumina

A project to develop 3D printed dielectric microwave and THz circuits using alumina.



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Seeking

Development partner

About **University of Birmingham**

At the University of Birmingham our research leads to new inventions and fuels innovation and business growth.

Background

Three-dimensional (3D) printing, also known as additive manufacturing, is now common place in many industries and is used widely to print a number of complex and demanding structures and components, from millimeter to meter scale. However, detailed work, together with demonstrator devices, is still in the very early stages in relation to the **manufacture of microwave and terahertz circuits**, in this day and age important for free space communications, security sensing and remote monitoring of the Earth's atmosphere. Microwave component manufacture requires a much higher level of precision and materials than currently available.

Tech Overview

This EPSRC - awarded project is to evaluate and improve the performance of 3D printing for microwave and terahertz passive and diode circuits (from 10 GHz to 1000 GHz) through measurement, design and demonstration. The focus is on evaluation of 3D printed circuits at frequencies above about 50 GHz, the small feature sizes required for these frequencies allows only the best printing process to compete; enabling the project to evaluate the most advanced 3D printing approaches.

A strong, experienced, national team is led by the world-class researchers at the University of Birmingham and the STFC Rutherford Appleton Laboratory (RAL). The Communications and Sensing research group at Birmingham University have already demonstrated significant research in this area, with 3D printed devices published covering the frequency range 0.5 GHz to 100 GHz. Birmingham's partners, the Millimetre Wave Technology Group in the RAL Space department, bring extensive expertise in precision manufacturing of conventional devices for these high frequencies, and knowledge of the demanding space and other requirements that the new 3D circuits must fulfill.

The project will look at two different types of materials for 3D printing: polymer (with metal coating) and **alumina**. Polymer 3D-printing is a well-established process and devices are largely reported (including by CS group, see details here), but their printing and application faces a number of challenges (power losses, thermal stability, etc) that will be addressed by the project.

Alumina, on the other hand, is a low-cost light-weight material, very attractive for microwave industry due to its low loss of microwave power. However, 3D printing of alumina with high precision is extremely challenging. One of the project partners, a 3D printing company, will feed its developments and know-how in alumina printing into the project.

Benefits

- Low-cost process and material
- Light-weight devices

- Low microwave power losses of the devices
- Good thermal stability of the devices
- Good power-handling
- Complex structures with micron precision generated
- Fast and efficient process

Applications

- Next generation communications,
- Free space communications,
- Security sensing,
- Remote monitoring of the Earth's atmosphere.

Opportunity

Co-development

The funding was obtained from EPSRC to support the project side studying polymer-printed microwave circuits. We are looking for a partner to support the **alumina printing side of the project.** The project will develop alumina 3D printed objects, measure their mechanical and microwave properties and develop new microwave components. The new components will be supplied to the partners who are interested in using the alumina devices for testing.