Additive Manufacturing of Metal/Ceramic Metamaterial Structures for RF Applications
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Athanasios Goulas[(1),] Reza Gheisari[(1)], Avishek Ghosh[(2)], Dawei Wang[(3)], Bala Vaidhyanathan[(2)], Ian M. Reaney[(3)], John (Yiannis) C. Vardaxoglou[(1)], Daniel S. Engstrøm[(1)]

[(1)] Wolfson School of Mechanical, Electrical & Manufacturing Engineering, Loughborough University, Loughborough, LE11 3TU, UK.
[(2)] Department of Materials, Loughborough University, Loughborough, LE11 3TU, UK.
[(3)] Department of Materials & Engineering, The University of Sheffield, Sheffield, S1 3JD, UK.

ABSTRACT

Metamaterials consist of a family of engineered materials whose properties do not exist in nature. They are novel electromagnetic materials (EM) whose effective properties are delivered by their structure rather than the bulk behavior of their materials they are composed of and their overall geometrical characteristics such as size, orientation and arrangement of their unit cells in space, is what grants them their desired electromagnetic properties (i.e. permittivity, permeability etc.). In the context of Radio-frequency (RF) communication, metamaterials are envisaged to be of use in planar antennae and various RF componentry, comprising of sub-wavelength highly ordered alternating arrays of conductive and dielectric materials with a characteristic structural length of one or more orders of magnitude smaller than the EM wavelengths of interest. The realization of such challenging composite materials, would require a fabrication process that can not only utilize a broad range of materials but also the ability to manufacture functional geometries of high geometrical complexity as given in the metamaterials scenario. Additive Manufacturing (also known as 3D Printing) possesses both the aptitude to process a wide range of engineering materials and the ability to deliver three-dimensional structures of high geometrical complexity as required for the realization of 3D metamaterials, with several benefits over traditional manufacturing methods used in the electronics manufacturing industry such as micro/nano-machining and lithography-based techniques. In this research project, we are investigating the application of combined metal/ceramic multi-material printing, followed by *in-situ* laser processing, to manufacture 3D metamaterial structures. The choice of both metallic and ceramic materials is discussed, together with their followed processing strategy and properties of resulting structures. The project is part the EPSRC Grand Challenge; SYMETA – SYnthesizing 3D METAmaterials for RF, microwave and THz applications (EP/N010493/1).

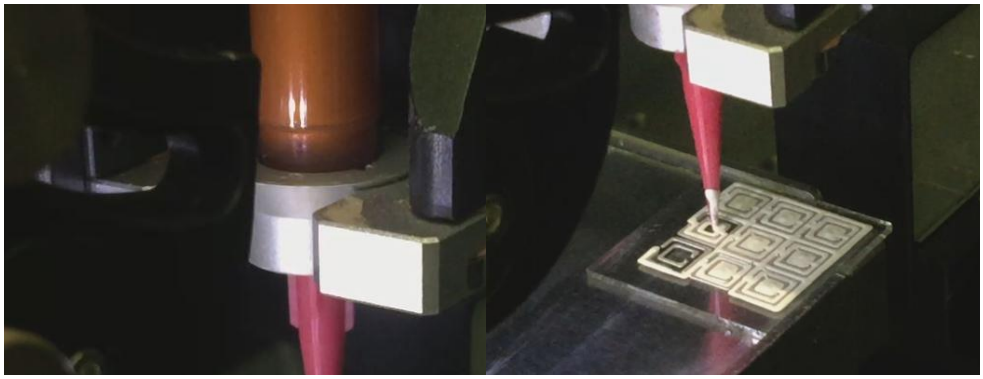

Figure 1. Printing of a Metal/Ceramic Array of Split Ring Resonators (SRR).