

Bio foundries for the mass production of metamaterials

S. Butler and R. Seviour,

University of Huddersfield, UK

Over the last 30 years' research and the use of RF metamaterials has increased exponentially, with a variety of applications, such as MRI scanners, antennas, phase-shifters, couplers, broadband/compact power-dividers and other devices such as beam steerers, modulators, band-pass filters and lenses. Metamaterials are artificial effective media, consisting of a periodic array of sub-wavelength structures (unit-cells) that produce an electromagnetic response not typically available in nature, with many unusual and promising features, derived primarily from their structure rather than their composition. For a system to be considered a metamaterial the individual unit cell geometry must be an order of magnitude smaller than the wavelength of interest, meaning the system is "effectively" homogenous. For visible light this defines a size range of between 40 to 70 nanometers for the unit cell of the metamaterial. Currently progress of metamaterial technologies is hampered by the lack of suitable mass production methodologies. Conventional hard, top down, nanofabrication methods for metamaterial production are costly or unwieldy on the scale required to fabricate sub 50nm constructs and present severe limitations of evolution from 2D to 3D structures.

In this poster, we discuss the use of biological systems as foundries for the mass, high fidelity, fabrication of sub-wavelength electromagnetic structures to form bulk metamaterials. We propose to use biological approaches, such as DNA origami, to create sub 50nm structures and selectively metallise certain regions. Create an engineered periodic 3D metal/semiconductor structure that will behave as a metamaterial. This approach would lead to a mass fabrication methodologies of artificial metamaterials which are cheaper, more reliable and quicker than current conventional approaches, and realise length scales currently unrealisable.