Origami inspired metamaterials and devices

Electromagnetic metamaterials have revolutionised the design of antennas, reflectarrays and many other electromagnetic components over the last decade. Currently however, once a material is designed and fabricated, its properties are fixed - unless each component is fitted with a complex array of electronics, which adds significant weight, bulk and cost. A family of materials that could be fabricated, and then readily altered *in situ*, would therefore have a myriad of applications in fields as diverse as communications, healthcare or environmental monitoring.

One route to achieving this is to use surfaces based on origami or kirigami techniques that can be folded or manipulated at will: These materials alter their geometries in a controlled way on the application of a stimulus, typically heat, light or moisture. This is generally achieved via the stimulus causing greater expansion in one part of the material (or composite material) than another, leading to bending. This process can be reversible or produce permanent changes, can create highly complex structures and has already led to innovations in microfluidics, energy storage and soft robotics.

This project will explore the possibilities of hybridising electromagnetic metamaterial components and origami/kirigami materials, to create a new family of reconfigurable structures, with a view to applications in telecommunications and beyond, and the expectation of the discovery of much new physics to drive future research.

The project will pull together elements of electromagnetic physics, mechanical engineering, and advanced materials and manufacturing. There are many exciting areas to explore, but the nature of the work will involve expanding your knowledge outside that of a single undergraduate discipline. Therefore this project would be ideal for an enthusiastic, highly motivated candidate looking to pursue exciting multidisciplinary, curiosity-driven research with real-world applications.

Please contact Dr. Alex Powell (a.w.powell@exeter.ac.uk) with any questions.

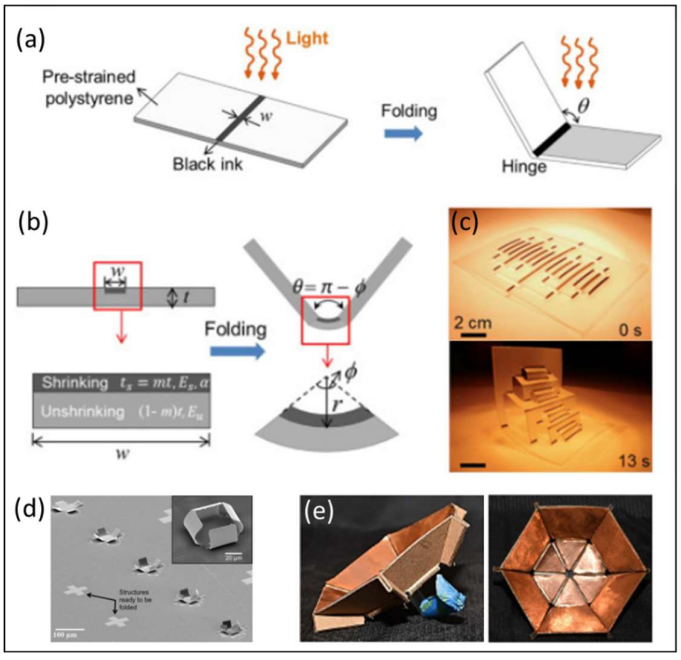

Figure 1 : Demonstrating the self-folding approach using photothermal excitation **a),b),** along with some complex structures that can be created by conbining this behaviour with a kirigami approach **c).** Examples of antenna structures fabvirated vie origami/kirigami on a variety of length scales are also shown **d),e).**