Magnonic crystals on flexible substrates: modelling, synthesis and properties

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This work is situated within the broad context of stretchable electronics, and more specifically within that of magnetic systems fabricated on flexible substrates which are of increasing interest. Indeed, the increasingly complex forms of electronic devices and smart textiles must incorporate magnetic functionality for data storage/transmission. From a general perspective, the main limitation of these deformable systems is often their insufficient durability. While substrates generally made of polymers are suitable for large deformations, the inorganic nanostructures that carry the magnetic functionality are inherently much more fragile. Thus, a major challenge is to understand the mechanical phenomena under large deformations as well as the links between these mechanical phenomena and magnetic behavior (due to magnetoelastic coupling). Here, we present the development of magnonic crystals (periodic array of magnetic nanostructures) lithographed on flexible substrates, targeting applications in multi-frequency stretchable/flexible magnetic systems. This work demonstrates, from both numerical and experimental perspectives, the effects of lateral nanostructuring of thin films on coupled mechanical and magnetic properties that can be optimized simultaneously. Particularly, we will demonstrate how to develop magnonic crystals whose spin wave spectrum remains relatively stable even under very large deformation or can be varied in a controllable manner.