Imagine a material that becomes thicker when you pull it, rather than thinner! Actually, such materials occur in nature, with examples including tendons, nacre (on shells) and even cat skin! Formally, such materials are said to have negative Poisson’s Ratio and are also known as auxetic. Designing synthetic variants of auxetic materials has been a long-standing goal, with all of the synthetic auxetic systems that we know of being made from ‘normal’ positive Poisson Ratio materials, carefully and cleverly engineered into auxetic structures, Figure 1(a).

Liquid crystal elastomers (LCEs) are amongst today’s most exciting soft-matter materials – they are crosslinked rubbers which include liquid crystalline units that provide order and anisotropy. LCEs exhibit shape-responsivity (Figure 1(b)) and programmability and can respond to light and heat in addition to mechanical actuation. In addition, we recently discovered the first synthetic material to display molecular auxeticity in a LCE that we designed and synthesised. Molecular auxetics have been a longstanding, unrealised goal for materials scientists for decades so this discovery offers a paradigm shift for materials science and engineering.

This talk describes how liquid crystal and auxetic properties combine to make an exciting new system with potential applications in areas as diverse as engineering, healthcare and electronics. The properties of liquid crystal elastomers will be described, including their negative Poisson’s ratio (Figure 1(c)). We will explain our current understanding of how a molecular-level synthetic auxetic material and suggest some exciting future directions for the materials.