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Switching an (improper) ferro-electric SmC* elastomer

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SmC* elastomers are the most complex and richest elastomers thus far synthesised. They can be made as large monodomain samples, free of textures and defects. They can be thought of having the physics of their underlying nematic elastomer order, with the smectic layer structure imposing additional rigid constraints for "strong" elastomers and not for "weak" elastomers.

I shall review the underlying thermal, mechanical and optical response of nematic elastomers. One can then discuss strong SmA and SmA* elastomers that already show subtle mechanical and electrical response, for instance 2-D rubber elasticity, mechanical Helfrich-Herault instabilities, and mechano-electro-clinic effects. With tilt in the C phase, there is the added complexity of shape change at low energy cost when the director rotates on the SmC cone about the layer normal.

SmC* elastomers couple to electrical, mechanical and optical (photo-isomerising) fields. They can therefore be switched in several ways - electrically to get mechanical response, mechanically to get optical and electrical response, optically to get mechanical and electrical response. I shall explore these responses, by first setting the scene with the large spontaneous mechanical shears induced by temperature or light when making the A-C transition.

The switching path depends on boundary conditions experienced by the elastomer. Typically textures develop as the director rotates by $\pm\Phi$. The textures rotate as the director advances, until when $\Phi=\pi$ the textures are lost to a switched monodomain structure.

In general the opto-mechanical response of SmC elastomers is poorly developed compared with experiment in SmC liquids and in nematic elastomers, and is a priority for the future.