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Título: Liquid Crystal Elastomers

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Precio: \$980.00

Editorial:

Año: 2007

Tema:

Edición: 1^a

Sinopsis

ISBN: 9780199214860

Liquid crystals are fluids with directionality defined. Polymers are long molecules with a shape that can be changed. As a network, polymers form rubber-a soft solid that is locally liquid-like and capable of huge extension. Liquid crystal elastomers are a combination of all these curious aspects, but with additional, revolutionary new phenomena-for example, spontaneous shape changes of several hundred percent induced by temperature change, with equally large opto-mechanical responses, shape change without energy cost (Soft elasticity), color change with strain, lasing and photonics, sensitivity to molecular handedness and soft solid ferroelectricity. This book is a primer for liquid crystals, polymers, rubber and elasticity. It then describes the theory and experiment of these remarkable materials for the first time as a monograph. Worked examples are solved so that the reader can become proficient in the field himself. The book is directed at physicists, chemists, material scientists, engineers and applied mathematicians at the graduate level and beyond.