# MECHANICALLY INDUCED MOLECULAR SWITCHING IN LIQUID-CRYSTAL ELASTOMERS

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## Abstract

Mechanical and X-ray scattering measurements on a side-chain liquid-crystal elastomer based on a crylate backbone are presented. The application of a stress field to the elastomer while in the nematic phase result in a stress-induced alignment of the mesogenic units in the direction of the extension. Extensions as low as 2% result in appreciable molecular alignment. The similarities of these effects with those observed in electric and magnetic fields are outlined.

**(Keywords: liquid-crystal elastomer: liquid –crystal polymer; orientation; molecular switching)**

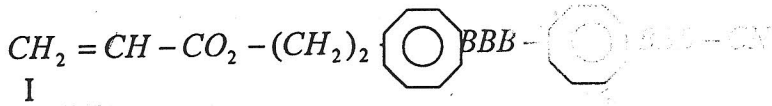
## Introduction

The design principles of side-chain liquid-crystal polymers are now well established [1,2]. These molecular composites comprise a flexible polymer backbone, a more or less rigid mesogenic unit, joined as a side-chain to the polymer backbone by a flexible coupling chain. By suitable chemical design, polymers can be synthesized that will exhibit[3,5] the well-known electric and magnetic field effects displayed by low molar mass counterparts[6]; i.e. a macroscopically aligned sample may be produced following the application of a suitable field*. In these effects the electric or magnetic field couples primarily to the rigid aromatic mesogenic unit, and so, for example, in a side-chain liquid-crystal polymer, the coupling subchain and the polymer backbone are not directly affected. However, the relatively short length of any coupling chain will result in some interaction between the mesogenic units and the polymer backbone chains, as is shown by theoretical studies[7] and from neutron scattering experiments[8,9].

We would expect the application of mechanical fields to side-chain liquid-crystal polymers to produce similar macroscopic alignment with the possibility of significant and interesting interactions between the various components of these molecular composites. However, with a conventional liquid polymer any applied static stress field will rapidly relax at rates dependent on the viscosity of the material, and thus only flow fields followed by rapid cooling generally result in orientation, as, for example, in fiber pulling. The synthesis of a crosslinked network within a liquid-crystal polymer framework to produce liquid-crystal elastomers[10,12] offers the possibility of applying static mechanical fields to induce molecular switching, and this communication records the preliminary results of such experiments.

## Materials

Liquid-crystal elastomers based on an acrylate backbone were produced by the free-radical copolymerization of mixtures of a mesogenic monomer I and a difunctional crosslinking unit II[13,14].



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*Certain types of electric fields with instabilities that will destroy any such macroscopic alignment.