

# Preface

The quest for responsive materials with the ability to mimic living systems is one of the major challenges for future polymeric materials. This requires a high level of mobility combined with shape retention. Both properties can be found in liquid-crystalline (LC) elastomers, in which crosslinks keep the shape and the liquid state guarantees mobility. These remarkable materials consist of polymeric liquid crystals in which mesogenic molecules are attached to a polymer backbone, which—in turn—is weakly cross-linked to form the elastomer. Like in other LC systems, their phase structure as well as functionality is found in a defined temperature range. The collective molecular organisation of LC elastomers requires new chemistry and physics. In addition, these materials provide new possibilities to study fundamental aspects of ordering and phase transitions in general.

The idea of the present volume came up at the International Liquid Crystal Elastomer Conference in 2005 in Cambridge (UK), but only became concrete at the 2009 conference at Kent (OH, USA). The motivation to start this project was threefold: (1) No comprehensive overview exists of the chemistry, material properties and experimental physics of LC elastomers. Such an overview would be a welcome addition to the existing literature. (2) The field of LC elastomers could be better imbedded in polymer science in general. A volume in the series *Advances in Polymer Science* might help to promote the field in a broader context. (3) Applications are gradually evolving, and reviewing the state of the art could stimulate further developments in this direction. Though several fascinating possibilities for applications have been proposed, a “smashing” one is still missing. Yet, in combination with novel preparation techniques like lithography, ink-jet printing and microfluidics, one can imagine new possibilities for applications of LC elastomers that would be difficult to achieve otherwise.

The book attempts to cover many of the aspects mentioned above. The first two chapters have a strong background in chemistry. In the first one by Felicitas Brömmel, Dominic Kramer and Heino Finkelmann (Freiburg, Germany), the preparation of LC elastomers is discussed. It treats the synthesis of LC polymer networks, mechanical orientation behaviour and liquid single-crystal elastomers. Coming from the late Freiburg group that had such an important impact in the field,

I expect it to be very welcome. The second chapter by Christian Ohm, Martin Brehmer and Rudolf Zentel (University of Mainz, Germany) treats applications of LC elastomers, mainly from a chemical point of view. The introduction on preconditions for selecting LC elastomers is followed by sections on actuators powered by a phase transition and on LC elastomers in electric fields. The following two chapters cover applications of LC elastomers, mainly from a physical point of view. Peter Palffy-Muhoray (Kent State University, Kent, OH, USA) discusses in a complementary way the effects of LC elastomers on light and of light on LC elastomers. In the next chapter Kenji Urayama (Kyoto University, Kyoto, Japan) treats electro-opto-mechanical effects in swollen nematic elastomers, including both static and dynamic aspects. The last two chapters cover some fundamental aspects of LC elastomers. Andrija Lebar, George Cordoyinassis, Zdravko Kutnyak and Boštjan Zalar (Jožef Stefan Institute, Ljubljana, Slovenia) discuss the isotropic to nematic conversion in LC elastomers on the basis of their extensive work using differential scanning calorimetry and nuclear magnetic resonance. Finally, Wim de Jeu (at that time University of Massachusetts, Amherst, MA, USA) and Boris Ostrovskii (Institute of Crystallography, Moscow, Russia) discuss order and disorder in relation to cross-linking in LC elastomers.

Editing a volume of reviews like the present one turned out to be not an easy task. I want to thank the various authors for the constructive interaction. I am grateful to some of them for delivering their contribution so timely, and to the others for not giving up during the process.

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