Alfred Saupe Prize 2013
Laudatio for Prof. Dr. Gerd Heppke

This year, Prof. Dr. Gerd Heppke, Technical University (TU) Berlin, received the Alfred Saupe Prize of the German Liquid Crystal Society for his outstanding work in the field of liquid crystals. The honouring ceremony was held at the 14th International Conference on Ferroelectric Liquid Crystals in Magdeburg in September (Fig. 1). The medal and the document of the prize were handed over to Prof. Heppke by Brigitte Saupe and Prof. Rudolf Zentel, Chairman of the German Liquid Crystal Society.

The international conference held in Magdeburg was an appropriate occasion to honouring Prof. Heppke's outstanding scientific merits, since chirality in liquid crystals and its influence on phase structure, phase transitions and electro-optic properties – including ferroelectricity – run like a golden thread through his original research, which received large international recognition. Many of his publications report pioneering ideas and visions that motivated cascades of further works by his colleagues.

Fig. 1. Prof. Heppke and his wife at the 14th International Conference on Ferroelectric Liquid Crystals in Magdeburg (September 2013), where Heppke received the Alfred Saupe Prize.

Being a physicist by training, Gerd Heppke started investigating basic properties of liquid crystals at the Technical University Berlin in the early 1970s. After his first publications together with Frank Schneider on order parameter measurements based on electron spin resonance spectroscopy, on conductivity, viscosity coefficients, elastic coefficients and magnetic field effects in nematic and smectic phases, he studied peculiarities in phase diagrams of nematic and smectic mixtures, such as the appearance of induced smectic phases, re-entrant nematic and re-entrant smectic phases, before he focussed his interests on the effects of chirality in liquid crystals and contributed to measuring, utilizing and optimizing the twist sense, the pitch and the temperature dependence of the pitch in chiral nematic mixtures.

In the early 1980s, Prof. Heppke was among the first researchers recognizing the importance of electro-optic effects in cholesteric blue phases (BP). Both the field-induced change of the BP-lattice constants [1] (later called electrostriction) and the field-induced change of the refractive index (Kerr effect) [2] were discovered by Heppke and his coworkers. While some contemporaries continued to consider blue phases as useless curiosities, Heppke had the farsightedness to recognize the advantages of an optically isotropic liquid crystal (that does not need an alignment layer) with a huge Kerr constant and relatively fast switching speed [2], although the efforts of enhancing the BP temperature range through polymer-stabilization [3] needed more than thirty years, before an important breakthrough was achieved [4(a)] and the first prototype of a blue phase liquid crystal display was presented [4(b)].

Heppke's pioneering work in liquid crystal physics was not only promoted by extensive collaborations with synthetic chemists, like Klaus Praefcke and Günter Scherowsky at TU Berlin, but also based on his readiness to build up his own synthetic chemistry laboratory,

which delivered sufficiently large quantities of entire homologous series of new compounds, which made very thorough systematic investigations possible. Some of these compounds had either very unusual properties or record-breaking performance, such as temperature-induced inversion of the helix sense or ultra high helical twisting power in induced cholesteric liquid crystals [5], or a first order SmC*-SmA* transition and an extremely high spontaneous polarization in ferroelectric liquid crystals [6,7]. For example, several homologous series of mesogenic α-chloro-carboxylic acids turned out not only to exhibit ferroelectric smectic phases with very high spontaneous polarization, but enabled also systematic studies of ferroelectric properties close to a first or second order SmC*-SmA* transition, observation of a critical point and measurement of the Landau coefficients [6], a very comprehensive work, which was renowned by the International Liquid Crystal Society with the Glenn H. Brown Prize 1990 for Heppke's student Christian Bahr. The initial work on ferroelectric liquid crystals (FLCs) was not only extended to studying ferri-electric and antiferroelectric behaviour, but also to higher ordered smectic phases [7]. Some of these smectic phases (for example SmQ* [8]) were found to appear only in chiral systems with sufficiently high enantiomeric excess, but not in the respective racemic mixture. Many FLCs were synthesized from natural organic compounds [6, 9]. Not only calamitic but also discotic liquid crystals were shown to exhibit short-pitch cholesteric phases [10], blue phases [11] and ferroelectric phases [11] and not only thermotropic but also lyotropic liquid crystals made from discotic molecules can exhibit ferroelectricity [12], according to the findings by Heppke and his coworkers. Not surprisingly, Gerd Heppke contributed also to the knowledge about the formation of chiral mesophases from bent-shaped achiral molecules [13] and studied in these systems together with other colleagues electric field-induced chiral separation [13], sulphur-containing bent-core compounds [14], and antiferroelectric switching [15-17] – including field-induced second harmonic generation [16] and efficient electro-optic light shutters [17].

Fig. 2. Workshop on Blue Phases held in the year 1989 at the Wissenschaftskolleg zu Berlin.

A third subject that is common to many of Heppke's publications is the development and investigation of glass-forming liquid crystals [18-20], which can facilitate structural studies or may be used for optical storage applications [18]. Again, studying such glass-forming materials included discotic [18], lyotropic [19] and bent-core [20] mesogens.

Beyond his scientific merits and his efforts promoting LC research as a regional editor of the journal Molecular Crystals and Liquid Crystals and member of the board of directors of the International Liquid Crystal Society, Prof. Heppke supported liquid crystal research remarkably through his visions and managing capabilities. In the early 1980s, Heppke

initiated together with Günter Scherowsky the first interdisciplinary scientific priority program „Liquid Crystal Mesophases and their Electrooptic Applications" at TU Berlin (Universitärer Forschungsschwerpunkt UF-1), which was coordinated by Heppke from 1981 to 1986. This program was continued by a Collaborative Research Centre "Anisotropic Fluids" (Sfb 331) funded by the German Research Foundation (DFG), which was coordinated by Siegfried Hess and Gerd Heppke from 1987 to 1998. Owing to these coordinated programs, Berlin became an internationally recognized centre of liquid crystal research in Germany, which attracted many scientists accepting a research fellowship or visiting one of the workshops in Berlin (Fig. 2) [21], which were very effective in setting the course of premature research areas.

On the occasion of bestowing the Alfred Saupe Prize, it should be mentioned that some of Heppke's multifaceted experimental works followed Alfred Saupe's pioneering footprints. For example, Alfred Saupe developed not only the famous Maier-Saupe theory, but was also the first theorist proposing a cubic superstructure of blue phases (a model, which is today generally accepted), explored the foundations of lyotropic liquid crystals and investigated the surface topography of vitrified liquid crystals by means of atomic force microscopy – ideas that were further elaborated and animated by Heppke's work. Prof. Gerd Heppke also trained and supervised numerous students and Ph. D. candidates, who continue teaching and research, thereby perpetuating Alfred Saupe's memory and the achievements in the field of liquid crystals.

Congratulations to Prof. Gerd Heppke on his decoration with the Alfred Saupe Prize!

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Further Reading

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