AUTOPRESENTATION

1. *Name and Surname:* DAMIAN STANISŁAW POCIECHA

2. *Held diplomas, degrees - with the name, place and year of acquisition and title of doctoral dissertation.*

1999 – PhD in chemistry (physical chemistry), Department of Chemistry, University of Warsaw, dissertation title: „Phase transitions and critical points in hexatic liquid crystals"

1994 – MSc in chemistry, Department of Chemistry, University of Warsaw

3. *Information on previous employment in scientific institutions*.

Since 2001 r. : assistant professor, Department of Chemistry, University of Warsaw
1999-2001 : assistant, Department of Chemistry, University of Warsaw

4. *Indication of achievements according to Art. 16 Paragraph 2 of the Act of Laws from 14 March 2003 on Academic Degrees (Dz. U. nr 65, poz. 595):*

a) publication cycle **"Structure and polar properties of liquid crystalline phases made of bent-core molecules"**

b) *List of publications:*

H1. E. Gorecka, D. Pociecha, F. Araoka, D. R. Link, M. Nakata, J. Thisayukta, Y. Takanishi, K. Ishikawa, J. Watanabe, H.Takezoe, „Ferroelectric phase in a chiral bent-core smectic liquid crystal: dielectric and optical second-harmonic generation measurements", *Phys. Rev. E*, **62**, R4524, (2000)
IF = 2.255 Number of citations – 64
(my contribution 25%: identification of new liquid crystalline phase, calorimetric, optical, electrooptic and dielectric studies, preparation of manuscript)

H2. J. Szydlowska, J. Mieczkowski, J. Matraszek, D.W. Bruce, E. Gorecka, D. Pociecha, D. Guillon, 'Bent-core liquid crystals forming 2D- and 3D- modulated structures', *Phys. Rev. E.*, **67**, 031702, (2003)
IF = 2.255 Number of citations - 79
(my contribution 25%: structural studies by xrd method, optical and electric measurements, preparation of manuscript)

H3. D. Pociecha, M. Čepič, E. Gorecka, J. Mieczkowski , "Ferroelectric mesophase with randomized interlayer structure", *Phys. Rev. Lett.*, **91**, 185501, (2003)
IF = 7.37 Number of citations - 32

(my contribution 50%: defining the subject of the studies, phase identification, optical and dielectric studies, preparation of manuscript)

H4. E. Gorecka, N. Vaupotič, D. Pociecha, M. Čepič, J. Mieczkowski, 'Switching mechanism in polar columnar mesophases made of bent-core molecules', *ChemPhysChem*, **6**, 1087, (2005)
IF = 3.412 Number of citations - 35
(my contribution 30%: xrd, electrooptic and dielectric studies, preparation of manuscript)

H5. V. Novotna, V. Hamplova, M. Kaspar, M. Glogarova, D. Pociecha, 'Switching of chirality from racemic to homochiral state in new liquid crystalline monomers with bent-core molecules', *Liq. Cryst*. **32**, 1115, (2005)
IF = 1.858 Number of citations - 17
(my contribution 20%: xrd studies, interpretation of results, preparation of manuscript)

H6. D. Pociecha, E. Gorecka, M. Čepič, N. Vaupotič, K. Gomola, J. Mieczkowski, 'Paraelectric-antiferroelectric phase transition in achiral liquid crystals, *Phys. Rev. E* **72**, 060701R, (2005)
IF = 2.255 Number of citations - 16
(my contribution 50%: defining the subject of the studies, calorimetric, optical, xrd and dielectric studies, preparation of manuscript)

H7. Y. Shimbo, Y. Takanishi, K. Ishikawa, E. Gorecka, D. Pociecha, J. Mieczkowski, K. Gomola and H. Takezoe, 'Ideal liquid crystal display mode using achiral banana-shaped liquid lrystals', *Jpn. J. Appl. Phys.*, **45**, L282–L284, (2006)
IF = 1.058 Number of citations - 38
(my contribution 20%: interpretation of results, preparation of manuscript)

H8. D. Pociecha, E. Gorecka, M. Čepič, N. Vaupotič, W. Weissflog, „Polar order and tilt in achiral smectic phases", *Phys. Rev. E*, **74**, 021702, (2006)
IF = 2.255 Number of citations - 11
(my contribution 50%: defining the subject of the studies, optical, xrd and dielectric studies, preparation of manuscript)

H9. Y. Shimbo, E. Gorecka, D. Pociecha, F. Araoka, M. Goto, Y. Takanishi, K. Ishikawa, J. Mieczkowski, K. Gomola and H. Takezoe, "Electric-field-induced polar biaxial order in a non-tilted smectic phase of an asymmetric bent-core liquid crystal", *Phys. Rev. Lett.*, **97**, 113901 (2006)
IF = 7.37 Number of citations - 33
(my contribution 15%: interpretation of results, preparation of manuscript)

H10. E. Gorecka, N. Vaupotic, D. Pociecha, „Electron Density Modulations in Columnar Banana Phases", *Chem. Mater.,* **19**, 3027-3031, (2007)
IF = 7.282 Number of citations – 12
(my contribution 40%: defining the subject of the studies, xrd structural studies, evaluation of the method for xrd patterns interpretation, preparation of manuscript)

H11. D. Pociecha, N. Vaupotič, E. Gorecka, J. Mieczkowski, K. Gomola, „2-D Density modulated structures in asymmetric bent-core liquid crystals", *J. Mater. Chem.*, **18**, 881, (2008)

IF = 5.968   Number of citations - 8
(my contribution 50%: defining the subject of the studies, xrd structural studies, optical measurements, preparation of manuscript)

H12. D. Pociecha, K. Ohta, A. Januszko, P. Kaszynski, Y. Endo, „Symmetric bent-core mesogens with m-carborane and adamantane as the central units", *J. Mater. Chem.*, **18**, 2978-2982, (2008)
IF = 5.968   Number of citations - 2
(my contribution 25%: xrd and electrooptic studies, phase identification)

H13. E. Gorecka, D. Pociecha, N. Vaupotič, M. Čepič, K. Gomola, J. Mieczkowski, „Modulated general tilt structures in bent-core liquid crystals", *J. Mater. Chem.*, **18**, 3044 – 3049, (2008)
IF = 5.968   Number of citations - 14
(my contribution 30%: xrd structural studies, phase identification, preparation of manuscript)

H14. N. Vaupotič, D. Pociecha M. Čepič, K. Gomola, J. Mieczkowski, E. Gorecka, 'Evidence for general tilt columnar liquid crystalline phase', *Soft Matter*, **5**, 2281–2285, (2009)
IF = 4.39   Number of citations - 6
(my contribution 30%: xrd structural studies, phase identification, preparation of manuscript)

H15. K. Gomola, L. Guo, D. Pociecha, F. Araoka, K. Ishikawa, H. Takezoe, 'An optically uniaxial antiferroelectric smectic phase in asymmetrical bent-core compounds containing a 3-aminophenol central unit', *J. Mater. Chem.*, **20**, 7944-7952, (2010)
IF = 5.968   Number of citations – 9
(my contribution 20%: xrd and electric studies, interpretation of results)

H16. V. Kozmik, P. Polasek, A. Seidler, M. Kohout, J. Svoboda, V. Novotna, M. Glogarova, D. Pociecha, 'The effect of a thiophene ring in the outer position on mesomorphic properties of the bent-shaped liquid crystals', *J. Mater. Chem.,* **20**, 7430–7435, (2010)
IF = 5.968   Number of citations - 1
(my contribution 30%: xrd studies, interpretation of results, preparation of manusript)

H17. L. Guo, K. Gomola, E. Gorecka, D. Pociecha, S. Dhara, F. Araoka, K. Ishikawa, H. Takezoe, 'Transition between two orthogonal polar phases in symmetric bent-core liquid crystals', *Soft Matter*, **7**, 2895, (2011)
IF = 4.39   Number of citations - 5
(my contribution 20%: xrd and dielectric studies, interpretation of results, preparation of manuscript)

H18. L. Guo, E. Gorecka, D. Pociecha, N. Vaupotic, M. Cepic, R. A. Reddy, K. Gornik, F. Araoka, N. A. Clark, D. M. Walba, K. Ishikawa, H. Takezoe, 'Ferroelectric behavior of orthogonal smectic phase made of bent-core molecules', *Phys. Rev. E*, **84**, 031706, (2011)
IF = 2.255   Number of citations - 2
(my contribution 30%: xrd and electric studies, interpretation of results,

preparation of manuscript)

H19. N. Vaupotic, D. Pociecha, E. Gorecka, „Polar and apolar columnar phases made of bent-core mesogens", *Top. Curr. Chem.*, **318**, 281-302, (2012)
IF = 2.607 Number of citations - 0
(my contribution 40%: xrd structural studies, preparation of manuscript)

H20. A. Kovářová, V. Kozmík, J. Svoboda, V. Novotná, M. Glogarová, D. Pociecha, "Naphthalene-based bent-shaped liquid crystals with a semifluorinated terminal chain", *Liq. Cryst.*, **39,** 755 – 767, (2012)
IF = 1.858 Number of citations - 0
(my contribution 20%: xrd and dielectric studies, interpretation of results)

c) Description of the scientific achievement

The series of publications, which I present as the basis for the habilitation concerns the structure and polar properties of liquid crystalline phases, smectic and columnar, formed by molecules with strongly bent mesogenic core (so-called *banana* phases, *banana* molecules). I have undertook this subject, as the first in Poland, soon after the pioneering reports on the special properties of *banana* phases, mainly on their polar properties exhibited in the absence of the molecular chirality. My studies on the mechanisms of developing of polar order in new type of liquid crystalline phases was motivated by my previous experience in research on ferroelectric and antiferroelectric liquid crystals made of chiral mesogens. I was also inspired by the ability of bent-core mesogens to form numerous liquid crystalline phases with two-dimensional density modulation. Conducting XRD structural studies, initially in the laboratory of the CNRS in Strasbourg, then in the Laboratory for Structural Research at the Department of Chemistry, University of Warsaw, in the creation of which I took an active part, I have described the structure of these phases. I have completed the structural studies by dielectric, optical and electrooptical measurements. Obtaining such complementary experimental results allowed me to propose a model of broken-layer type columnar phases. It also allowed for a better understanding of the relationship between molecular structure of mesogens and properties of liquid crystalline phases they exhibit.

The studies I have conducted required the cooperation of many groups specializing in different aspects of material science, that explains the presence, among the coauthors of the papers, of organic chemists (groups from Warsaw University, Charles University in Prague, Czech Academy of Sciences, Tokyo Institute of Technology) and theoretical physicists (from University of Maribor and Josef Stefan Institute in Ljubljana).

Until 1990's research on liquid crystals (LCs) focused mainly on two large groups of compounds with molecules having linear (rod-like) and discotic (disc-like) mesogenic cores. The first group of compounds predominantly forms lamellar structures (smectics) while the second forms columnar structures. Liquid crystalline phases formed by both groups of compounds can have polar properties: ferroelectric, ferrielectric or antiferroelectric, under two conditions: molecules must be chiral and their cores must be tilted with respect to smectic layer normal (or column axis) – in such a case symmetry of the phase is reduced enough to allow for polar ordering. It was not until 1996 when it was shown that also achiral molecules can exhibit polar liquid crystalline phases [T. Niori, T. Sekine, J. Watanabe, T. Furukawa and H. Takezoe, J. Mater. Chem., 1996, 6, 1231-1233]. This surprising discovery was obtained by a simple trick: the core of the molecules was bent by an angle of approx. 120 deg (Fig. 1).

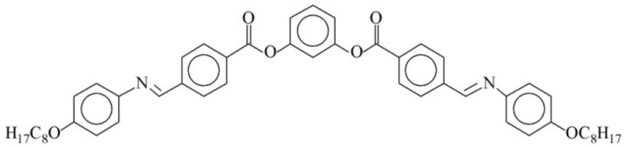

Fig. 1 Molecular structure of the prototype bent-core mesogen. Bending angle is approx. 120 deg.

Bent-core molecules (often referred to as *banana* molecules in literature), despite their shape, can form phases typical for rod-like compounds – non-polar smectics, and nematics or non-polar columnar phases. However, most often due to the steric reason such molecules freeze their rotation around long molecular axis (defined as the line connecting the ends of the molecular core), which leads to the ordering of their transverse dipole moments (Fig. 2). If the order of dipole moments in the smectic layer is long range a spontaneous electric polarization of a layer appears despite of absence of molecular chirality. What is different from rod-like systems is

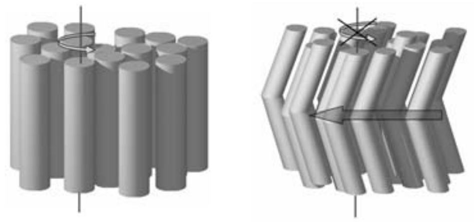

Fig. 2 In rod-like SmA phase molecules rotate freely around their long axis, in the mesophase made of bent-core molecules rotation is frozen due to steric reason, which leads to spontaneous electric polarization indicated by arrow.

that tilting of molecules from layer normal is not necessary for polar ordering – decoupling of the tilt and polar orders for bent core molecules allows for existence of polar orthogonal smectics, synclinicaly tilted phase that is antiferroelctric or ferroelectric phase with anticlinic arrangement of molecules in consecutive layers. In chiral rod-like systems the anticlinic/synclinic tilt order is always united with the antiferroelectric/ ferroelectric polar order and non-tilted phases are always apolar.

The bent-core mesogens are also unusual because of their ability to form a variety of two dimensional (2D) density modulated structures. Such phases are only rarely encountered for rod-like molecules, as the formation of 2D structures requires special molecular architecture (strong longitudinal dipole moment or multiple terminal chains). Contrary to the rod-like molecules, in the case of the bent-core molecules there are no special molecular prerequisites for the formation of 2D structures, they are frequent and found for symmetric as well as asymmetric molecules, for molecules with strong and weak dipole moments, multiple terminal chains are also not required.

Polar properties of smectic phases of bent-core molecules

There are six basic polar lamellar structures that can be formed by bent-core molecules: two orthogonal with ferroelectric ($SmAP_F$) or antiferroelectric ($SmAP_A$) arrangement of spontaneous polarization in neighboring layers and four tilted (referred to as B_2 phases in literature) with different combination of tilt and polarization in consecutive layers: synclinic ferroelectric (SmC_SP_F), synclinic antiferroelectric (SmC_SP_A), anticlinic ferroelectric (SmC_AP_F) and anticlinic antiferroelectric (SmC_AP_A). Not all of them are commonly observed – tilted antiferroelectric phases are the most often formed. It is worth to notice that two of tiled phases, SmC_SP_F and SmC_AP_A, are structurally chiral although molecules forming them are achiral (Fig. 3).

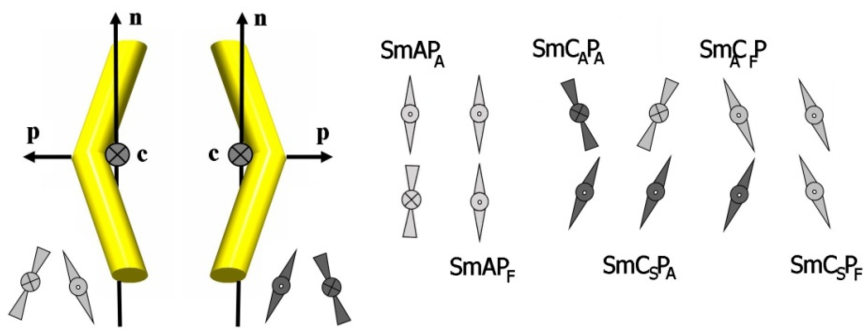

Fig. 3 (left) Three vectors: layer normal **n**, polarization **p** and director projection onto smectic layer **c**, can form right- or left-handed system, this makes polar smectic layer structurally chiral. (right) Arrangement of tilt and polarization directions in consecutive layers of f polar smectic phases of bent-core molecules.

First reports about discovery of ferroelectric B_2 phase appeared in 1999 [J. P. Bedal, H. T. Nguyen, J. C. Rouillon, J. P. Marcerou, G. Sigaud, P. Barois, Mol. Cryst. Liq. Cryst. 332, 163 (1999); D. M. Walba, E. Korblova, R. Shao, J. E. Maclennan, D. R. Link, M. A. Glaser, N. A. Clark, Science 288, 2181 (2000)].
However, the conclusion of ferroelectricity in these studies has been made based on the observation of a single peak in the polarization reversal current, which is not a definite proof, as the single current peak can be also observed in antiferroelectric phase if the restoring of ground AF state is slow comparing to the period of applied voltage.

In a paper H1 we have described bent-core material forming B_2 phase with ferroelectric ground state - SmC_AP_F giving for the first time unambiguous evidences for ferroelectric character of the phase. Ferroelectricity was confirmed by dielectric spectroscopy (a mode with dielectric strength an order of magnitude larger than in antiferroelectric B2 phases was detected) and by second harmonic generation (SHG) method – non-zero SHG signal was observed in ground state. Moreover, by observations of optical textures vs. applied electric field for studied ferroelectric phase in contact with material forming SmC_SP_A phase we have identified tilt arrangement in consecutive layers as anticlinic one – thus the ground structure was SmC_AP_F.

Ten years later we have presented (paper H18) evidences for ferroelectric orthogonal smectic phase, $SmAP_F$ formed by asymmetric bent-core molecules having carbosilane end group at one of the molecular branches. We proposed that ferroelectric structure of the phase, confirmed by SHG and dielectric spectroscopy methods, is a consequence of partial decoupling of the smectic layers due to the segregation of carbosilane molecular parts at the layer interface – presence of carbosilane sublayer was determined from x-ray diffraction studies.

In papers H6 and H8 we have described development of polar ordering in orthohogonal smectic phases of bent-core molecules (in sequence paraelectric SmA – antiferroelectric $SmAP_A$ phase) and its coupling to the tilt order (sequence SmA – $SmAP_A$ – $SmCP_A$). By dielectric spectroscopy we have shown that polar order in $SmAP_A$ phase arises by gradual condensation of molecular fluctuations, namely rotations around long molecular axes. In SmA phase such fluctuactions have individual character - relaxation frequency, f_r, of related dielectric mode follows the Arrhenius behavior. On cooling toward $SmAP_A$ critical slowing down of fluctuactions is observed as departure of f_r from Arrhenius behavior – fluctuactions become more collective and finally condense into stable structure of $SmAP_A$ phase at the phase transition. From the very low value of relaxation frequency of ferroelectric mode at the SmA-$SmAP_A$ phase transition we have deduced that in studied system antiferroelectric coupling between spontaneous polarization of consecutive layers is orders of magnitude weaker than in chiral rod-like systems.

Studying LC material showing sequence of smectic phases: orthogonal paraelectric – orthogonal antiferroelectric – tilted antiferroelectric we were able to show that in bent-core system the polar order and tilt order actually are not independent – clearly appearance of molecular tilt causes strong increase of spontaneous polarization. Tilting of molecules at SmAP – SmCP phase transition is preceded by strong fluctuations of the long molecular axis directions, which we have monitored by precise measurements of birefringence in function of temperature.

In papers H5 and H20 we have described series of mesogenic bent-core materials forming B_2 phase, some of them showed interesting switching behavior – under application of ac voltage, ground state changed from achiral SmC_SP_A into a chiral one, SmC_AP_A.

Apart of basic polar lamellar phases described above the bent-core compounds might form number of phases that are special only for this group of materials. Structure and properties of one of them - the optically uniaxial orthogonal smectic phase with polar order – we have described in paper H3. The phase was named smectic A randomized ($SmAP_R$) and we proposed a structure in which all smectic layers are polar and polarization vectors in consecutive layers makes an angle, which is constant in value but degenerated in sign – this for stacking number of layers leads to uniaxiality of the phase. Further studies of this type of a phase, done in collaboration with Japanese group of prof. Takezoe (H7, H9, H15, H17) yielded an alternative model for $SmAP_R$ phase – according to this model the phase is paraelectric with exceptionally large polar, ferroelectric or antiferroelectric, domains, which can interact collectively with electric field. We have shown that properties of $SmAP_R$ phase, optical uniaxiality in ground state and large, linear field-induced biaxiality, make it ideal candidate for LC displays.

Yet another lamellar structure of bent-core molecules having m-carborane central unit, intercalated smectic B_6 phase was described in H12. The phase has no long range polar order, however it showed interesting, threshold-like dependence of birefringence on electric field.

Structure of 2D density modulated (columnar) phases of bent-core molecules

Columnar phases are surprisingly often observed for bent core molecules and no any special molecular structure is necessary. These phases can be viewed as built of smectic layer fragments (blocks) that are laterally shifted one against another (Fig. 4). The molecular blocks can be arranged into 2D lattice with rectangular or oblique unit cell, with two objects per crystallographic unit cell. The block cross section

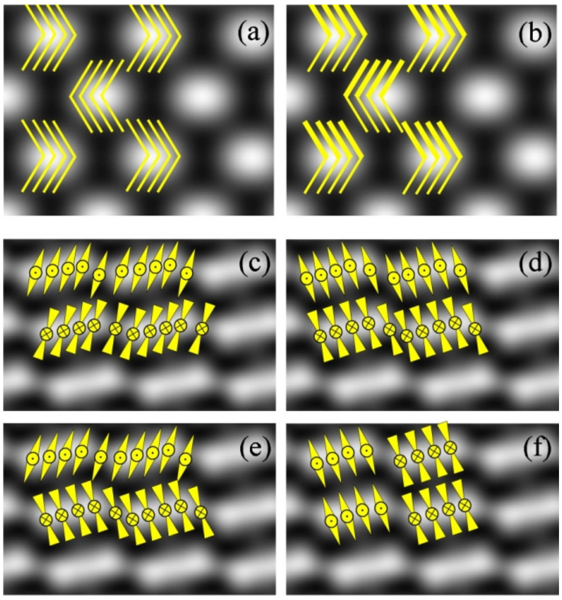

Fig. 4 . Few possible combinations of tilt and polarization for B_1 (a,b) and B_{1Rev} (c-f) phases presented over electron density maps of the phases (the brighter – the higher electron density).

consist of few to hundred molecules, depending very much on material and temperature.

The first reported columnar phase of bent core molecules was B_1 phase, built from non-tilted layers fragments, in which density modulations occur in the plane containing polarization vector [J. Watanabe, T. Niori, T. Sekine, and H. Takezoe, *Jpn. J. Appl. Phys.*, Part 1 **37**, L139, (1998)]. Building blocks of B_1 phase are polar and they are arranged into antiferroelectric structure, however the phase is not switchable under electric field.

In 2003, in the paper H2 we have showed another 2D modulated phases of bent-core molecules, for which we have introduced name B_{1Rev}. We have proposed two structures, in which density modulations occur in the plane perpendicular to column polarization vector, columns are stacked in antiferroelectric manner and the difference between phases is that columns are built of non-tilted or tilted layer fragments, B_{1Rev} and $B_{1RevTilted}$, respectively. Contrary to B_1 phase, the phases we have discovered are switchable, moreover $B_{1RevTilted}$ can switch in two ways – by collective rotation of molecules around tilt cone, or by rotation around long molecular axis, in the latter case, with inversion of local chirality. Detailed studies on switching mechanisms in B_{1Rev} - type phases (published in paper H4), showed that the type of the switching depends mainly on the waveform of applied voltage and the size of the column cross-section.

In recent years we have created new laboratory, well equipped with x-ray diffractometers dedicated to studies of soft mater structure. Having access to high quality diffraction data we have developed a new strategy for extracting information on the structure of 2D density modulated phases, based on reconstruction of electron density maps through the reversed Fourier transformation. This approach we have presented in paper H10 and successfully used for structural studies of phases of bent core mesogens (H11, H13, H14 and H16). Among others we have shown that there can be two general types of 2D modulated phases in bent-core systems (Fig. 5). The in-layer interactions between bulky molecular cores lead to splay of polarization direction within the layer and in consequence to undulation/breaking of the smectic layers and formation of B_{1Rev} - type phases. On the other hand, interactions between layers may cause formation of dimeric (bilayer) units; frustration in the system, which arises if bilayer periodicity is not exactly commensurate with single layer thickness, may be released by the periodic in-layer density modulation, such phases are named modulated lamellar.

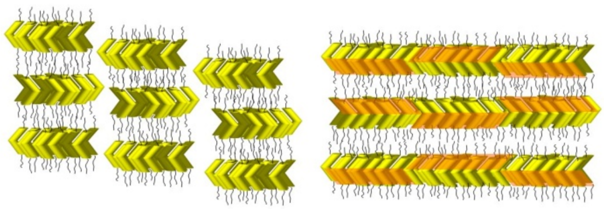

Fig. 5 . Two possible 2D modulated structures: (left) columnar phase made of broken layer fragments and (right) modulated lamellar phase in which additional density modulation (marked by orange color) is formed along continuous layer.

In papers H13 and H14 we have proved, by x-ray diffraction method, existence of LC phases having local 'general tilt' structure (Fig. 6). In most cases of polar tilted smectic phases the polarization vector is perpendicular to the tilt plane, however it was postulated that also structures with polarization component out of the tilt plane can exist, named smectic C

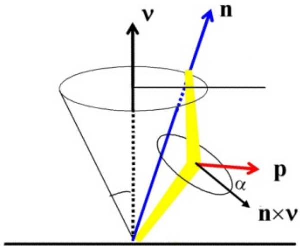

Fig. 6 . In polar smectic phase with 'general tilt' structure polarization vector **p** makes a non-zero angle a with tilt plane normal, **n** x ν.(**n** – director, ν - layer normal)

general, SmC_G. We have shown that local SmC_G structure may be responsible for formation of modulated smectic phases, or for appearance of additional density modulations superimposed on the 2D structure of B_{1Rev} – type phase.

Our studies on 2D density modulated phases of bent-core mesogens were summarized in review paper H19.

5. *Other scientific achievements*

a) summary of scientific achievements (Web of Science and Scopus, 14 Aug 2012)

130 publications: 128 articles in journals included In Thomson Reuters Journal Citation Reports and 2 book chapters
Total IF = 466.9 (3.67/publ.)
Number of citations - 1425 (10.96/publ.)
Number of citations without self-citations = 1150
Hirsch index h = 22

b) list of publications

before PhD

1. W. Pyżuk, J. Szydłowska, E. Górecka, A. Krówczyński, D. Pociecha, J. Przedmojski "Phase diagram and phase transitions studies of homologous series with both tilted and orthogonal hexatic phases", *Mol. Cryst. Liq. Cryst.* **260**, 449-459, (1995)
   IF = 0.58 Number of citations - 4
2. W. Pyżuk, E. Górecka, J. Szydłowska, A. Krówczyński, D. Pociecha "Multicritical point involving hexatic smectic phases", *Phys. Rev. E.* **52**, 1748-1753, (1995)
   IF = 2.255 Number of citations - 12
3. A. Krówczyński, J. Szydłowska, D. Pociecha, E. Górecka "New lath-like liquid crystalline Cu(II) enaminoketone complexes." *Pol. J. Chem.* **70**, 32-35, (1996)
   IF = 0.393 Number of citations - 1
4. A. Krówczyński, E. Górecka, D. Pociecha, J. Szydłowska, J. Przedmojski "Mesogenic properties of 1,2,3-tri-[3'-(4"-alkoxyphenylo)-3'-oxo-1-propenyloamino)-propane" *Liq. Cryst.* **20**, 607-610, (1996)
   IF = 1.858 Number of citations - 4
5. W. Pyżuk, E. Górecka, A. Krówczyński, D. Pociecha, J. Szydłowska, J. Przedmojski, Li Chen, "Enaminoketones as new hydrogen bonded liquid crystals", *Liq.Cryst.* **21**, 885-891, (1996)
   IF = 1.858 Number of citations - 10
6. A. Krówczyński, D. Pociecha, J. Szydłowska, J. Przedmojski, E. Górecka "Non-discoidal copper(II) and nickel(II) binuclear complexes forming columnar mesophases", *Chem. Commun.*, 2731, (1996)
   IF = 6.169 Number of citations - 9
7. I. Bikchantaev, J. Szydłowska, D. Pociecha, A. Krówczyński, E. Górecka "Molecular rotation in hexatic B mesophase studied by the EPR method", *Mol. Cryst. Liq. Cryst.* **303**, 121-126, (1997)

IF = 0.58 Number of citations - 3

8. J. Szydłowska, D. Pociecha, A. Krówczyński, E. Górecka "Tilted and orthogonal smectics in thienyl and furyl substituted enaminoketones", *Mol. Cryst. Liq. Cryst.* **301**, 19-24, (1997)
IF = 0.58 Number of citations - 6

9. D. Pociecha, A. Krówczyński, J. Szydłowska, E. Górecka, M. Glogarová "Properties of chiral liquid crystals with inner hydrogen bond", *J. Mater. Chem*. **7**(9), 1709, (1997)
IF = 5.968 Number of citations - 6

10. I. Bikchantaev, J. Szydłowska, D. Pociecha, A. Krówczyński, E. Górecka, "Restricted molecular rotation in hexatic B and crystalline B mesophases as studied by the electron paramagnetic resonance method", *J. Chem. Phys.* **107** (21), 9208-9213, (1997)
IF = 3.333 Number of citations - 5

11. J. Mieczkowski, E. Górecka, D. Pociecha, M. Glogarová, "New ferroelectric liquid crystals with cyclic and non-cyclic chiral groups", *Ferroelectrics*, **212**, 357-364, (1998)
IF = 0.391 Number of citations - 10

12. A. Krówczyński, J. Szydłowska, D. Pociecha, J. Przedmojski, E. Górecka; "Calamitic or columnar mesomorphism determined by the number and position of substituents in enaminoketone Cu(II), Ni(II), Co(II) complexes"; *Liq.Cryst.* **25**, 117-121, (1998)
IF = 1.858 Number of citations - 15

13. P. M. Johnson, C. C. Huang, E. Gorecka, D. Pociecha; "High-resolution heat-capacity studies of the hexatic-B smectic-F phase transition in liquid-crystal compounds"; *Phys. Rev. E* **58**, 1207 R, (1998)
IF = 2.255 Number of citations - 2

14. E. Górecka, D. Pociecha, M. Glogarová, J. Mieczkowski; "Observation of a frustrated phase in mixtures of ferroelectric and antiferroelectric liquid crystals"; *Phys. Rev. Lett*. **81**, 2946 (1998)
IF = 7.37 Number of citations – 35

after PhD

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IF = 1.858 Number of citations - 3
(my contribution 20%: xrd measurements, interpretation of results)

89. P. Niton, A. Zywocinski, R. Holyst, R. Kieffer, C. Tschierske, J. Paczesny, D. Pociecha, E. Gorecka, 'Reversible aggregation of X-Shaped bolaamphiphiles with partially fluorinated lateral chains at the air/water interface', *Chem. Commun*. **46**, 1896-1898, (2010)
IF = 6.196 Number of citations – 5
(my contribution 15%: xrd measurements, interpretation of results)

90. J. Szydlowska, A. Krówczyski, D. Pociecha, J. Szczytko, P. Budzowski, A. Twardowski, E. Górecka, 'Dinuclear Mesogens with Antiferromagnetic Properties', *ChemPhysChem*, **11**, 1735-1741, (2010)
IF = 3.412 Number of citations - 0
(my contribution 15%: xrd measurements, interpretation of results)

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IF = 1.858 Number of citations - 4
(my contribution 15%: optical and xrd measurements, interpretation of results)

93. A. Iwan, P. Rannou, H. Janeczek, M. Palewicz, A. Hreniak, P. Bilski, F. Oswald, D. Pociecha, 'Liquid-crystalline phases formed by symmetrical azines with different terminal chains. Thermal, optical and electrical study', *Synth. Met.*, **160**, 859-865, (2010)
IF = 1.829 Number of citations - 3
(my contribution 10%: xrd measurements)

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(my contribution 5%: xrd measurements)

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IF = 4.39 Number of citations - 8
(my contribution 25%: xrd measurements, interpretation of results, preparation of manuscript)

97. V. Kozmik, P. Polasek, A. Seidler, M. Kohout, J. Svoboda, V. Novotna, M. Glogarova, D. Pociecha, 'The effect of a thiophene ring in the outer position on mesomorphic properties of the bent-shaped liquid crystals', *J. Mater. Chem.,* 20, 7430–7435, (2010)
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(my contribution 10%: xrd measurements)

99. A. Kovářová, J. Swoboda, V. Novotná, M. Glogarová, M. Salamonczyk, D. Pociecha, Ewa Gorecka, '[2]Benzothiophene bent-shaped liquid crystals', *Liq. Cryst.*, **37**, 1501- 1513, (2010)
IF = 1.858 Number of citations - 3
(my contribution 15%: optical and xrd measurements, interpretation of results, preparation of manuscript)

100. A. Iwan, D. Sek, D. Pociecha, A. Sikora, M. Palewicz, H. Janeczek, „New discotic-shaped azomethines with triphenylamine moieties: Thermal, structural behaviors and opto-electrical properties", *J. Mol. Struct.*, **981**, 120-129, (2010)
IF = 1.634 Number of citations - 2
(my contribution 10%: xrd measurements)

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(my contribution 15%: xrd measurements, interpretation of results)

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(my contribution 15%: xrd measurements, interpretation of results)

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(my contribution 15%: xrd measurements, interpretation of results, preparation of manuscript)

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IF = 1.858 Number of citations - 5
(my contribution 20%: xrd measurements, interpretation of results, preparation of manuscript)

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IF = 4.39 Number of citations - 4
(my contribution 20%: xrd measurements, interpretation of results, preparation of manuscript)

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IF = 4.186 Number of citations - 0
(my contribution 10%: xrd measurements)

108. P. Nitoń, A. Żywociński, J. Paczesny, M. Fiałkowski, R. Hołyst, B. Glettner, R. Kieffer, C. Tschierske, D. Pociecha, E. Górecka, 'Aggregation and Layering Transitions in Thin Films of X-, T-, and Anchor-Shaped Bolaamphiphiles at the Air-Water Interface', *Chem. Eur. J.*, **17**, 5861 – 5873, (2011)
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(my contribution 5%: 5 xrd measurements, interpretation of results)

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IF = 2.255 Number of citations - 2

110. M. Wojcik, M. Gora, J. Mieczkowski, J. Romiszewski, E. Gorecka, D. Pociecha, 'Temperature-controlled liquid crystalline polymorphism of gold nanoparticles', *Soft Matter*, **7**, 10561-10564, (2011)
IF = 4.39 Number of citations - 1
(my contribution 20%: xrd measurements, interpretation of results, preparation of manuscript)

111. V. Novotna, V. Hamplova, N. Podoliak, M. Kaspar, M. Glogarova, D. Pociecha, E. Gorecka, „Chiral liquid crystalline compounds with a re-entrant SmA* phase", *J. Mater. Chem.*, **21,** 14807–14814, (2011)
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(my contribution 10%: xrd measurements, interpretation of results)

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IF = 1.858 Number of citations - 4
(my contribution 20%: xrd measurements, interpretation of results)

113. K. Winkler, M. Paszewski, T. Kalwarczyk, E. Kalwarczyk, T. Wojciechowski, E. Gorecka, D. Pociecha, R. Holyst, M. Fialkowski, 'Ionic Strength-Controlled Deposition of Charged Nanoparticles on a Solid Substrate', *J. Phys. Chem. C*, **115**, 19096–19103, (2011)
IF = 4.805 Number of citations - 2
(my contribution 5%: xrd measurements)

114. A. Iwan, E. Schab-Balcerzak, D. Pociecha, M. Krompiec, M. Grucela,P. Bilski, M. Kłosowski, H. Janeczek, 'Characterization, liquid crystalline behavior, electrochemicaland optoelectrical properties of new poly(azomethine)s and a poly(imide)with siloxane linkages', *Opt. Mater.,* **34**, 61–74, (2011)
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(my contribution 5%: xrd measurements)

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IF = 2.255 Number of citations - 0
(my contribution 10%: xrd measurements, interpretation of results)

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(my contribution 5%: xrd measurements)

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IF = 1.858 Number of citations - 0
(my contribution 15%: xrd measurements, interpretation of results)

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IF = 9.907 Number of citations - 2
(my contribution 20%: optical and xrd measurements, interpretation of results, preparation of manuscript)

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(my contribution 15%: xrd measurements, interpretation of results)

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(my contribution 15%: xrd measurements, interpretation of results)

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IF = 2.289 Number of citations - 0
(my contribution 10%: xrd measurements)

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124. T.-N. Chan, G.-Y. Yeap, W.-S. Yam, K. Madrak, A. Zep, D. Pociecha, E. Gorecka, „A crossover from rod-shaped to bent-shaped in symmetric isoflavone liquid crystal trimers exhibiting unusual mesomorphic behaviour", *J. Mater. Chem.*, **22**, 11335 - 11339, (2012)
IF = 5.968 Number of citations - 0
(my contribution 10%: xrd measurements, interpretation of results, preparation of manuscript)

125. P. Krzyczkowska, A. Krówczyński, J. Kowalewska, J. Romiszewski, D. Pociecha, J. Szydłowska, „ Mesogenic enaminoketone Ni(II) complexes of phenazine and quinoxaline derivatives", *Mol. Cryst. Liq. Cryst.,* **558**, 93 – 101, (2012)
IF = 0.58 Number of citations - 0
(my contribution 15%: optical and xrd measurements, interpretation of results)

126. J. Paczesny, P. Nitoń, A. Żywociński, K. Sozański, R. Hołyst, M. Fiałkowski, R. Kieffer, B. Glettner, C. Tschierske, D. Pociecha, E. Górecka, 'Stable, ordered multilayers of partially fluorinated bolaamphiphiles at the air–water interface', *Soft Matter*, **8**, 5262 – 5272, (2012)
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(my contribution 5%: xrd measurements)

127. A. Bubnov, V. Novotná, D. Pociecha, V. Hamplová, M. Kašpar, "Effect of alkyl chains length on properties of ferroelectric liquid crystals with the keto group attached to the molecule core", *Phase Transitions*, DOI:10.1080/01411594.2012.684880, (2012)
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(my contribution 15%: xrd measurements, interpretation of results)

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IF = 1.858 Number of citations - 0
(my contribution 15%: xrd measurements, interpretation of results)

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IF = 1.858 Number of citations - 0
(my contribution 15%: xrd measurements, interpretation of results, preparation of manuscript)

130. A. Jankowiak , D. Pociecha , H. Monobe , J. Szczytko, P. Kaszyński, „Thermochromic discotic 6-oxoverdazyls", *Chem. Commun.*, **48**, 7064-7066, (2012)
IF = 6.169 Number of citations - 0
(my contribution 20%: optical and xrd measurements, interpretation of results, preparation of manuscript)

c) list of conference presentations (without posters):

1. D. Pociecha, E. Gorecka, M. Cepic, N. Vaupotic, K. Gomola, J. Mieczkowski, W. Weissflog, 'Development of polar order and tilt in achiral smectics', lecture at 21st International Liquid Crystal Conference, Keystone, USA, (2006).
2. D. Pociecha, E. Górecka, N. Vaupotič, "Electron density modulations in columnar banana phases", invited lecture at 11th Ferroelectric Liquid Crystals Conference, Sapporo, Japonia, (2007).
3. D. Pociecha, "X-ray diffraction studies of liquid crystalline phase structure", invited lecture on XX School on Physics and Chemistry of Condensed Matter, Białowieża, Polska, (2009).
4. D. Pociecha, E. Gorecka, N. Vaupotič, „2-D density modulated structures of bent-core mesogens", invited lecture at XVIII Conference on Liquid Crystals, Augustów, Polska, (2009).
5. D. Pociecha, M. Wojcik, W. Lewandowski, M. Kolpaczynska, J. Matraszek, A. Krowczynski, J. Mieczkowski, E. Gorecka, „ Liquid crystalline phases made by functionalized gold nanoparticles", lecture at 23rd International Liquid Crystal Conference, Kraków, Polska, (2010).

6. D. Pociecha, M. Wojcik, W. Lewandowski, J. Mieczkowski, K. Madrak, J. Szczytko, N. Vaupotič, E. Gorecka, „Self-assembling of metal nanoparticles”, invited lecture at European Conference on Liquid Crystals, Maribor, Słowenia, (2011).

d) Summary of research activities (references to the list in 5.b)

I have started my research in the last years of graduate course at the Faculty of Chemistry, Warsaw of University. Main subject of my research is physics and chemistry of liquid crystalline materials. In particular, I am interested in structural studies of phases created by the new mesogenic materials, often with unusual molecular structure and in the phase transition between mesophases.

In the doctoral dissertation "Phase transitions and critical points in hexatic liquid", defended in February 1999, I have presented liquid crystalline properties of more than seventy new mesogenic substances and the results of studies of transitions between orthogonal and tilted smectic phases, showing long range correlations of local crystallographic axis directions (bond orientational order). I have proved that these transitions are well described be mean-field model, and determined the value of the critical exponent for these transitions [20].

Much of my published papers are related to polar properties of liquid crystalline phases, formed by chiral or achiral molecules. Among others I have described:

- relaxor-type liquid crystalline phases, whose polar properties, intermediate between ferroelectric and antiferroelectric depend to a large extent on the history of the sample [14, 22]

- reentrant ferroelectric smectic C phase (re-SmC*) that occurs in the phase sequence: Iso – SmC* - $SmC*_A$ - re-SmC* [26]

- for the first time, the complete phase diagram of the prototype antiferroelectric LC material, MHPOBC, as a function of optical purity, which explained the differences in previously published phase sequence in this compound [34]

- axially polar columnar phase (in which the polarization vector is directed along the axis of the column) formed by a bent-shaped polycatenar mesogens [46, 54]

Another area of my research work is related to liquid crystalline phases formed by metallomesogens - complexes of transition metals, which have mesogenic cores of intermediate shape between linear and discotic. In our papers we have shown that these materials, depending on the number, type and place of attachment of the terminal groups may form a one- or two-dimensional periodically modulated structures, smectic and columnar phases, respectively [24, 66, 76]. The type of the phase formed can also changed in function of temperature - in such a case columnar and smectic phases are separated by reentrant isotropic phase, which leads to unique phase sequence Iso - Col_h - Iso_{re} - SmA, in this sequence phase without long-range positional order (Iso_{re}) occurs at temperatures lower than positionally ordered, columnar phase [35].

In recent years I have undertook studies on new hybrid liquid crystalline systems – metal nanoparticles, coated with a double organic layer formed by alkyl chains and larger molecules with a rigid mesogenic core. We have shown that the flexibility of the organic coating allows spherical gold nanoparticles to form phases with one-, two- and three-dimensional positional order [77, 96]. We have also presented the first material made of gold nanoparticles showing polymorphism of liquid crystalline phases as a function of temperature - phase sequence Sm - Col_r - Col_h [110].

6. *Other information*

a) teaching

Physics – exercises, laboratory
Physicochemistry of new materials – laboratory,
Physicochemistry of condensed matter – lecture, laboratory
Crystallography – laboratory

b) research grants

Research grant **T09A 147 10**, „Ferroelectric properties of mesogenic enaminoketone derivatives", grant leader

Research-training grant **HPRN-CT-2002-00171**, 'Fullerene-Based Advanced Materials for Optoelectronic Utilizations-FAMOUS', principial investigator

Research grant **ESF/2007/03**, „Liquidcrystalline nanoparticles", principial investigator

Research grant **4 T09A 00425**, „Mesoscale self-organization of non-linear mesogenic molecules", principial investigator

Research grant **2006/CZ-08**, „Structure-property relationships of new liquid crystalline materials possessing polar phases", grant leader

Research grant **COST/52/2006**, „Low-temperature metallomesogens: novel materials with defined photophysical, magnetic and electric properties", principial investigator

Research grant **POLONIUM 6480/R06/R07**, „Bent-core mesogens", grant leader

Research grant **2008/CZ-6**, „Phases and structures formed by new bent-shaped molecules", grant leader

Research grant **2010/SLO-10**, "Liquid crystalline phases by metal nanoparticles", grant leader

c) awards

1997 – Antoni Grabowski Price for PhD student from Department of Chemistry, UW
1998 – Scholarship from Fundation for Polish Science
2000 – Prime Minister Price for PhD thesis
2002 – Antoni Grabowski Price from Department of Chemistry, UW
2003 – Department of Chemistry, UW scientific award
2003 – 2008 Warsaw University Rector Scholarship
2007 – Wiktor Kemula Price from Department of Chemistry, UW

Damian Pociecha