Chapter 7

Synthesis and mesomorphic properties of

(i) **1-(2-Fluoro-4-*n*-alkoxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoates)**

Series- 7.1

(ii) **1-(3-Fluoro-4-*n*-alkoxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoates)**

Series- 7.11

(iii) **1-(2-Fluoro-4-*n*-alkoxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoates)**

Series- 7.111

(iv) **1-(3-Fluoro-4-*n*-alkoxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoates)**

Series- 7.IV

(v) **1-(2-Fluoro-4-*n*-alkoxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecylbenzoyloxy-4-benzoates)**

Series- 7.V

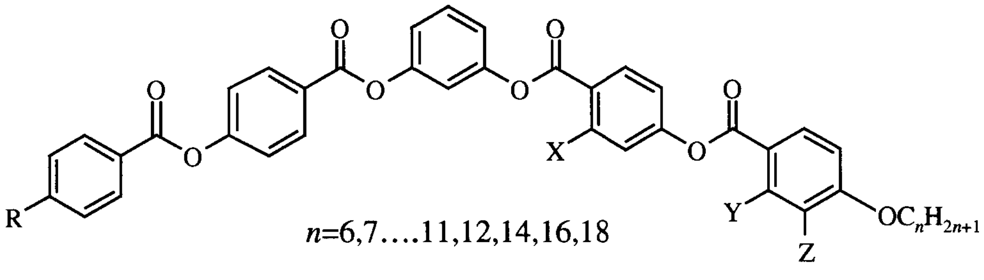
(vi) **1-(3-Fluoro-4-*n*-alkoxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecylbenzoyloxy-4-benzoates)**

Series- 7.VI

Introduction

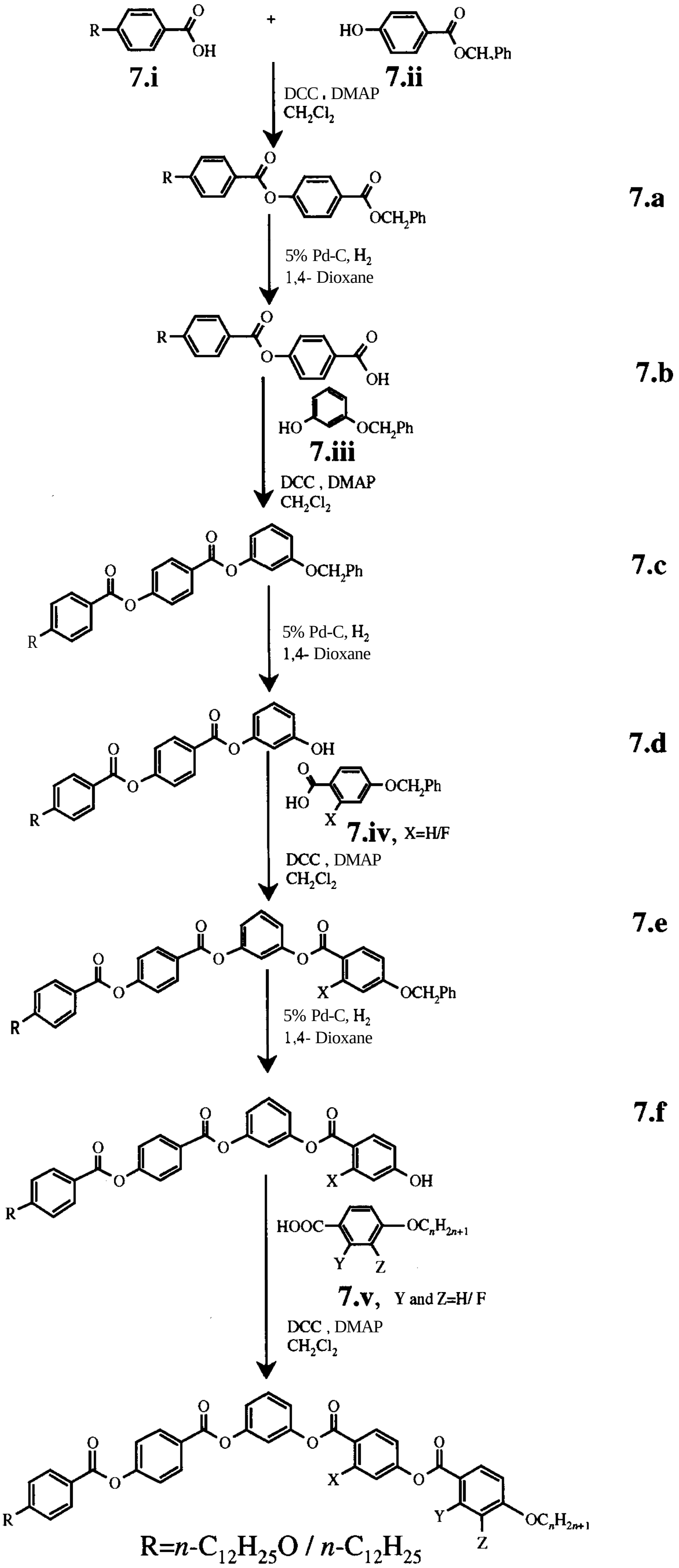
Synthesis of bent-core compounds with different chemical architecture is of topical interest in understanding the relationship between the chemical structure and mesophase behaviour. Most of the BC compounds exhibiting mesophases that have been reported in the literature are symmetrical about the central unit and are derived from 1, 3-dihydroxybenzene [28, 29, 45, 48, 53, 54], 2, 7-dihydroxynaphthalene [55, 100-1021 and benzene 1, 3-dicarboxylic acid [41]. Introduction of lateral substituents on the arms of BC molecules for modifying the mesomorphic properties have been studied [31, 53, 58] on a number of different systems. In view of the small size of a fluorine substituent and a fairly high value of electronegativity, it has been used with advantage as a lateral substituent in evaluating the mesomorphic properties of bent-core compounds [23, 31, 38, 51, 53, 58, 73]. The large electronegative value of fluorine is responsible for the high polarization of C-F bond, which induces strong local dipole moment and is instrumental in generating new mesophases with different properties. Many compounds reported in the literature so far have fluorine substitution on both the arms of the BC compounds [23, 29, 38, 51, 53, 73] and hence are symmetrical about the central phenyl ring.

In this chapter, the mesomorphic properties of six homologous series of unsymmetrical compounds with a lateral fluorine substituent in only one of the arms of the BC molecules are discussed. In these compounds, the terminal chain on one of the arms is fixed with a n-dodecyloxy / n-dodecyl chain and the other terminal chain length is varied. The general structure of the unsymmetrical compounds belonging to the six homologous series is shown in structure **7.1.**



Structure 7.1

R= n-$C_{12}H_{25}O$	X=H,	Y=F,	Z=H	Series- **7.1**
	X=H,	Y=H,	Z=F	Series- **7.II**
	X=F	Y=F,	Z=H	Series- **7.III**
	X=F,	Y=H,	Z=F	Series- **7.IV**
R= n-$C_{12}H_{25}$	X=F,	Y=F,	Z=H	Series- **7.V**
	X=F,	Y=H,	Z=F	Series- **7.VI**



R=n-$C_{12}H_{25}O$ / n-$C_{12}H_{25}$

n=6,7...12,14,16,18

Structure 7.1

Scheme 7.1: Synthetic pathway used to prepare the unsymmetrical bent-core compounds.

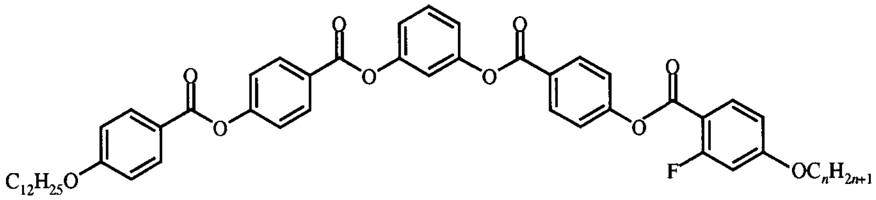
Synthesis

The synthetic pathway used to prepare the unsymmetrical bent-core compounds having the general structure **7.1** is shown in scheme **7.1.** Benzyl-4-hydoxybenzoate and resorcinol were commercial compounds and used without further purification. 3-Benzyloxyphenol was prepared following a procedure described in the literature [104]. 4-Benzyloxybenzoic acid [59], 2-fluoro-4-benzyloxybenzoic acid [59-61], 2-fluoro-4-*n*-alkoxybenzoic acids and 3-fluoro-4-n-alkoxybenzoicacids [61, 63] were prepared following procedures described in the literature.

Results and discussion

The transition temperatures and the associated enthalpy values for the compounds of series **7.1** are summarized in table **7.1.** Two types of mesophases were observed in this series of compounds. When a thin film of a sample of compound **7.A.1** was cooled from the isotropic phase and observed under a polarizing microscope, mosaic texture similar to that obtained for a B_1 phase was observed. A similar optical feature was observed for compound **7.A.2** also. However, when a sample of compound **7.A.3** was cooled slowly from the isotropic phase, both mosaic as well as spherulitic texture developed. Immediately, a fingerprint (fringe pattern) texture that is typically observed for a B_2 phase began to appear on the existing spherulites. In some other region of the same sample a schlieren texture was also observed. Optical photomicrographs of these changes observed are shown in figure **7.1.** These textural features remain even on further cooling and when heated go over to the isotropic liquid without any change. Although the clearing transition is seen as a fairly sharp peak on a DSC thermogram, in the cooling scan this transition clearly shows a splitting corroborating the observations made under a polarizing microscope. A DSC thermogram obtained for compound **7.A.3** is given in figure **7.2.** A transition from the rectangular columnar B_1 phase to a lamellar antiferroelectric B_2 phase is rather rare and has been reported only in a couple of systems [105-107]. The occurrence of such a transition in the present system is due to the proximity of the clearing temperatures of the B_1 and B_2 phases exhibited by compounds **7.A.2** and **7.A.3** respectively.

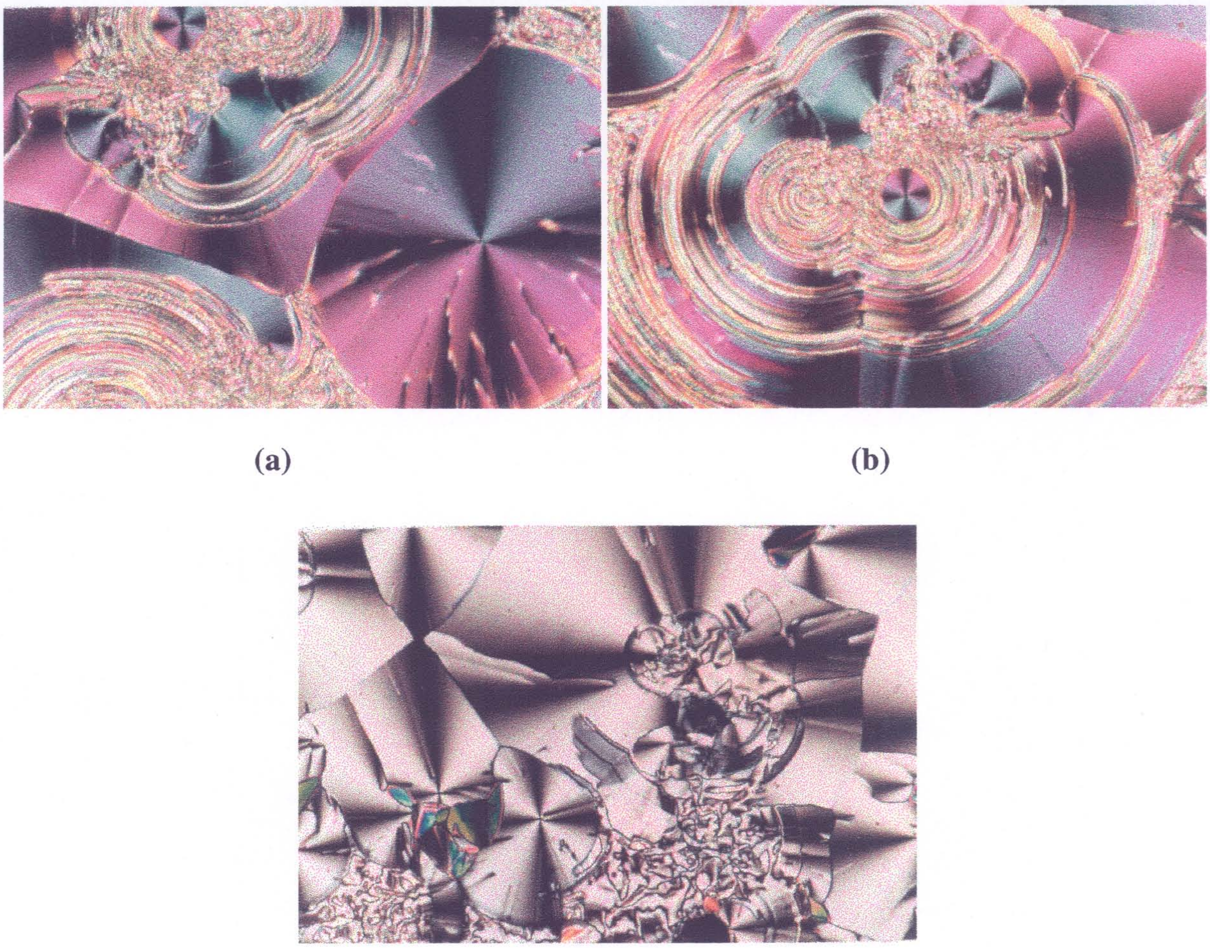
Table 7.1: Transition temperatures (°C) and the associated enthalpies (kJ mol^{-1}) for the unsymmetrical compounds of series 7.1



Compound	*n*	Cr		B$_2$		B$_1$		I
7.A.1	6	.	99.0^{a} *80.6*	-		(.	97.0) *14.7*	.
7.A.2	7	.	97.0 *51.3*	-		(.	96.5) *15.5*	.
7.A.3	8	.	99.0^{a} *48.7*	(.	$97.0)^{\#}$ *16.7*	.		.
7.A.4	9	.	90.0 *29.4*	.	101.0 *19.5*	-		.
7.A.5	10	.	90.0 *30.3*	.	104.0 *21.0*	-		.
7.A.6	11	.	96.0^{a} *49.4*	.	106.0 *21.1*	-		.
7.A.7	12	.	98.0^{a} *42.4*	.	107.5 *21.7*	-		.
7.A.8	14	.	80.0^{a} *34.2*	.	109.5 *22.3*	-		.
7.A.9	16	.	79.0 *37.0*	.	110.0 *22.2*	-		.
7.A.10	18	.	79.0 *40.3*	.	110.5 *23.5*	-		.

Key: Cr: crystalline phase; B$_2$: smectic antiferroelectric mesophase; B$_1$: columnar phase with a rectangular lattice; I: isotropic phase; ( ): monotropic mesophase.

a: compound has crystal- crystal transition and enthalpy denoted is the sum of all such transitions. $^{\#}$: compound exhibits a transition from B$_1$ to B$_2$ phase upon cooling the isotropic phase.



(a) (b)

(c)

Figure 7.1 (a) and (b): Optical photomicrographs showing the growth of the B_2 mesophase over the spherulitic pattern of the B_1 mesophase; (c) schlieren texture of B_2 phase growing on the B_1 phase in a different region; compound 7.A.3.

A study of a large number of compounds has indicated that the occurrence of B_1 and B_2 phases is dependent on terminal chain length. Although it has been shown from calculations [108] that the conformation of the terminal chain changes as a function of its length in a single molecule with an energy gap of 2.6 kJ mol^{-1}, there is no evidence so far for a change of the conformations of the molecules during the transition between B_1 and B_2 phases. Further, the transition between these phases involves a conformational change for a great number of molecules, which will cost high energy and hence is not a common occurrence. Interestingly this kind of transition was observed [105] only on cooling. However, there are atleast two reports [106, 107] where such a transition has been seen both on heating and cooling.

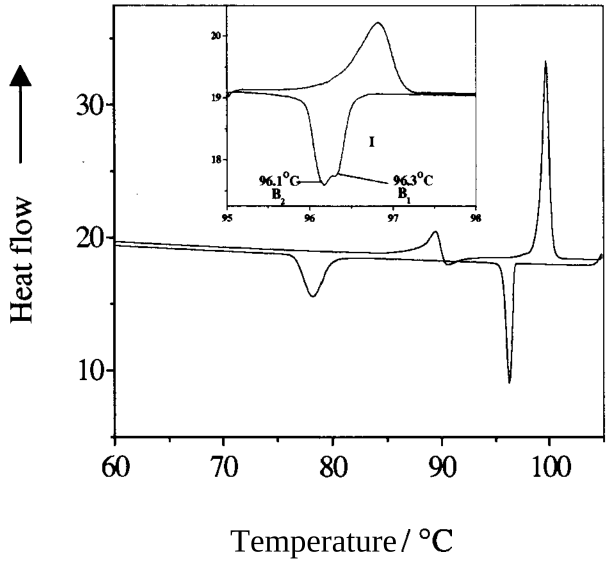


Figure 7.2: A DSC thermogram of compound 7.A.3; inset shows the monotropic B_1 to B_2 phase transition; rate: 0.5° min^{-1}.

To confirm the mesophase structures, X-ray diffraction studies were carried out. The sample was taken in a Lindemann capillary (0.7 mm), the ends of which were sealed and placed in a heater, whose temperature was controlled by a computer to an accuracy of ± O.l°C. For compound **7.A.1** two reflections were obtained in the small angle region at d_1=26.2Å and d_2=21.6Å which could be indexed to (11) and (02) reflections from a rectangular lattice with lattice parameters, a=33 and b=43.2. The wide-angle diffuse reflection at d=4.6Å, corresponds to the mean distance between the fluid n-alkoxy chains. This data combined with optical textures obtained for compound **7.A.1** was adequate in arriving at the phase assignment as B_1.

On increasing the chain length further (compounds **7.A.4** to **7.A.10)** only the B_2 phase was observed. **A** photomicrograph of a typical texture obtained for the B_2 phase of compound **7.A.5** is shown in figure **7.3. A** plot of transition temperatures as a function of n-alkoxy chain length for compounds of series **7.1** is shown in figure 7.4. The clearing transition points for this mesophase follow a smooth curve as shown and is typical for a B_2 phase.

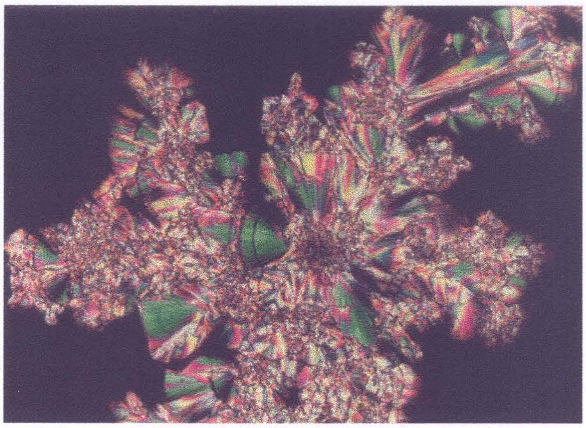


Figure 7.3: An optical photomicrograph of a texture of B_2 mesophase obtained on cooling the isotropic phase of compound 7.A.5.

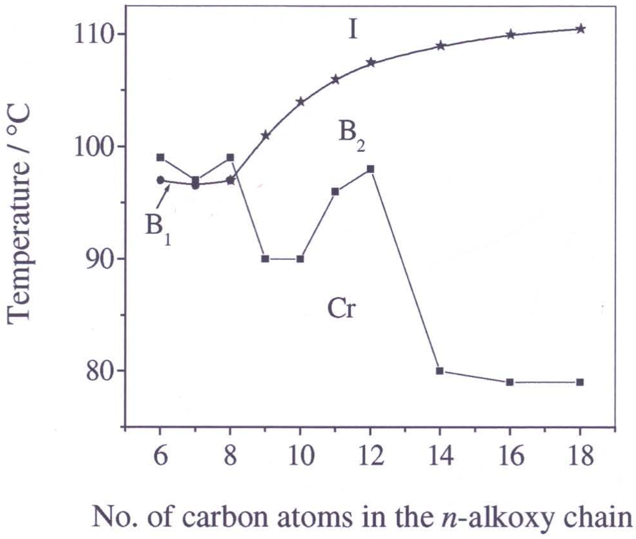


Figure 7.4: A plot of transition temperatures as a function of the number of carbon atoms in the *n*-alkoxy chain for compounds of series 7.I.

The XRD pattern of compound **7.A.5** showed three sharp reflections in the small angle region besides a diffuse wide-angle reflection at 4.6Å. The reflections d_1=34Å, d_2=17Å and d_3 =11.3Å are in the ratio of 1:1/2:1/3 indicating a smectic ordering for the mesophase. Based on this data together with electro-optical switching (described later) and textural observations the mesophase was labeled as B_2.

To examine the effect of an ac electric field on the mesophases, the triangular-wave method was employed. For example, compound **7.A.3** was taken in a ITO coated cell treated for homogeneous alignment of the sample of thickness 11.1μm. The sample was cooled very slowly from the isotropic phase. The spherulitic texture of B_1 appeared and on further cooling by 0.2°C the fringe pattern also appeared. On applying a triangular-wave voltage of 331V_{pp} at a frequency of 40Hz, two polarization current peaks per half cycle was observed indicating the antiferroelectric ground state structure for the lower temperature phase. A typical switching current response trace obtained for compound **7.A.3** is shown in figure **7.5**. The saturated polarization value obtained by integrating the area under the two peaks is about 530 nC cm^{-2}. The optical textures obtained under these conditions are shown in figure **7.6**. All these observations clearly indicated that the lower temperature phase is B_2.

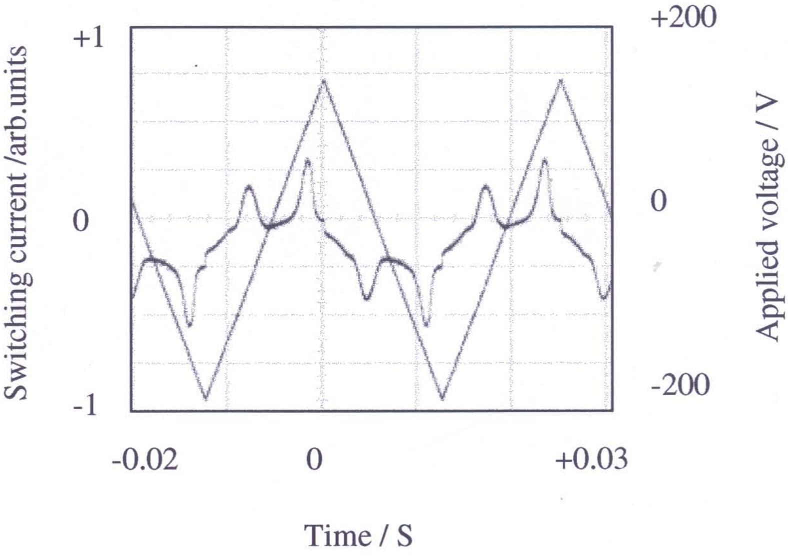


Figure 7.5: **Switching current response trace obtained for the mesophase of compound 7.A.3 by applying a triangular-wave electric field (331V_{pp}, 40Hz); cell thickness: 11.1μm; the saturate polarization ≈ 530 nC cm^{-2}.**


(a) **(b)**

Figure 7.6: Optical photomicrographs obtained for the B_2 mesophase of compound 7.A.3 (a) with the electric field; (b) without the electric field.

Similarly the traingular-wave experiments were carried out on the mesophase of compound **7.A.5** and a typical switching current response obtained is shown in figure **7.7.**

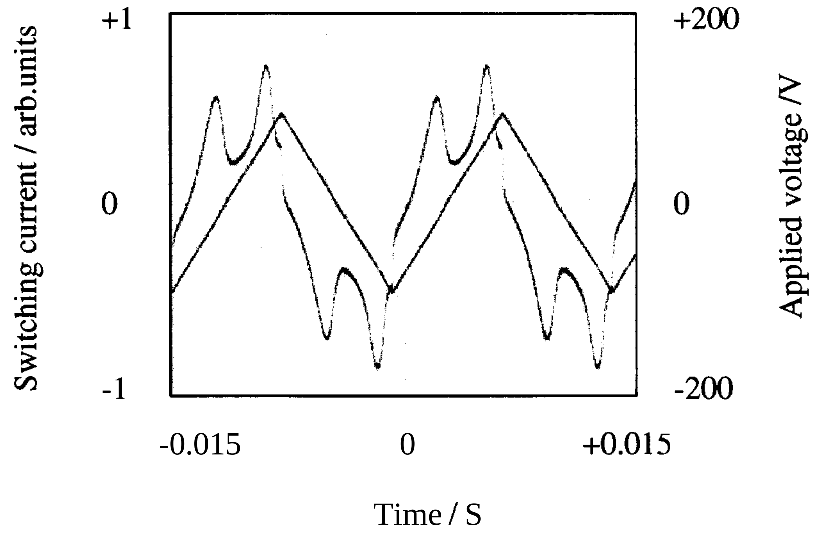


Figure 7.7: Switching current response trace obtained for the mesophase of compound 7.A.5 by applying a triangular-wave electric field (188V_{pp}, 60Hz); cell thickness: 10.1μm; the saturated polarization ≈ 510 nC cm^{-2}.

The dc field experiments on the mesophase of compound **7.A.5** were carried out to confirm the tilt sense of the molecules in ther B_2 phase.. The sample was taken in a cell of thickness 10 ym, the inner surfaces of which were treated for a homogeneous alignment of the sample. On slow cooling the isotropic liquid of compound **7.A.5** under a dc electric field of about 5.5 $V\mu m^{-1}$, circular domains were obtained in which the director of bent-core molecules aligned parallel to the substrate. The dark (extinction) brushes thus obtained make an angle of about 45" w.r.t. the directions of the crossed polarizers and are independent of the polarity of the applied field and are as shown in figure **7.8 (a)** and **7.8 (b).** This is an indication of a 45" synclinic tilt of molecules w.r.t. the layer normal in the field induced ferroelectric state (SmC_SP_F). In this case, the extinction obtained is independent of the field reversal. On switching off the field, one would expect an anticlinic antiferroelectric ground state (SmC_AP_A) with the extinction along the directions of the crossed polarizers. However, as shown in figure **7.8 (c)** no change in the position of the extinction cross could be seen on switching off the field. However, a significant change in the colour of the circular domains could be observed. This unusual observation is possibly due to the field-induced state stabilized by the surface, which prevents the relaxation of the molecules into the ground state (SmC_AP_A).

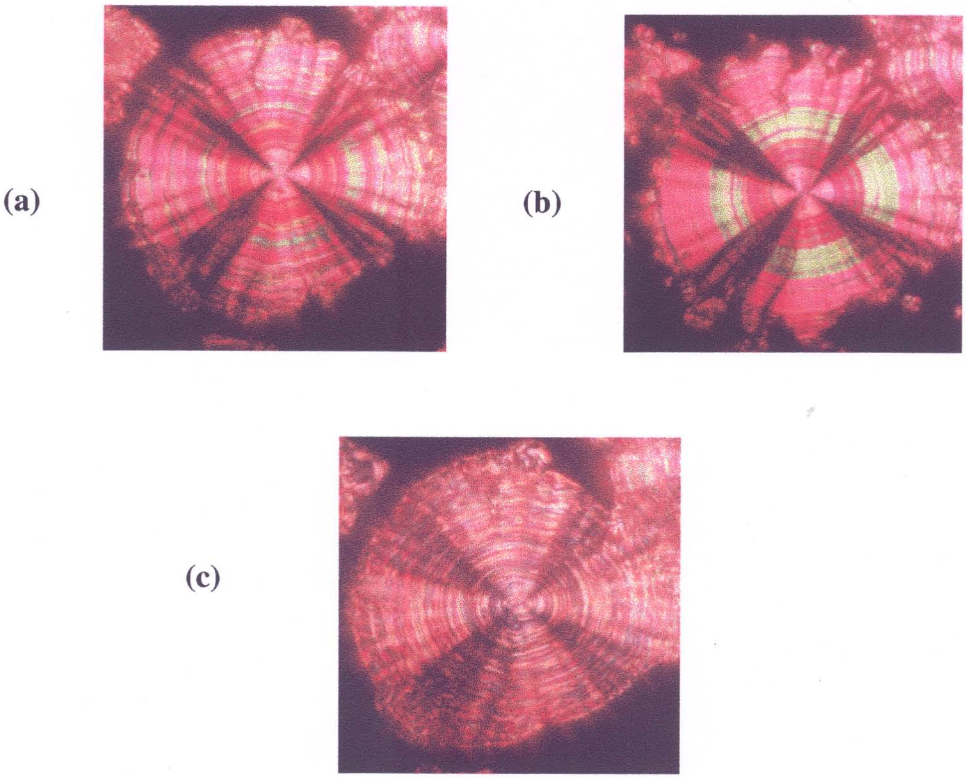
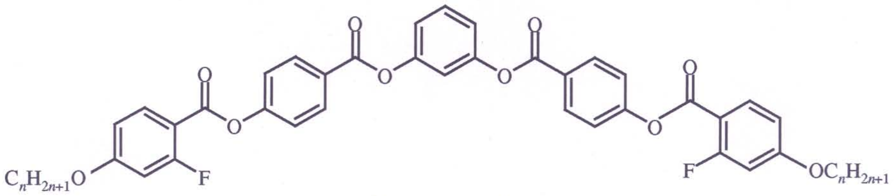


Figure 7.8: Optical photomicrographs of the effect of dc field on the mesophase of compound 7.A.5; (a) + 5.5 V μm^{-1} (b) – 5.5 V μm^{-1} (c) 0 V.

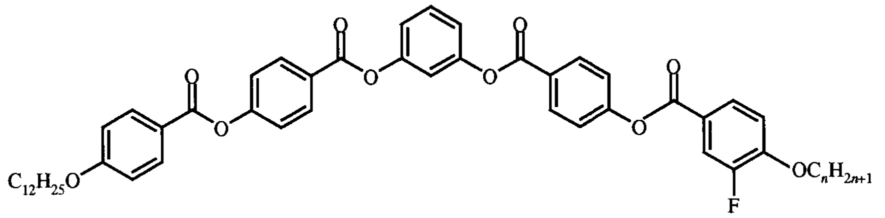
The mesomorphic behaviour of the unsymmetrical compounds of series **7.I** was compared with those of the symmetrical analogues (Structure **A**) reported earlier [58]. The significant difference between the two is that the unsymmetrical series of compounds have lower melting points for the B_2 phase and hence the thermal range for this phase is larger.



Structure **A**

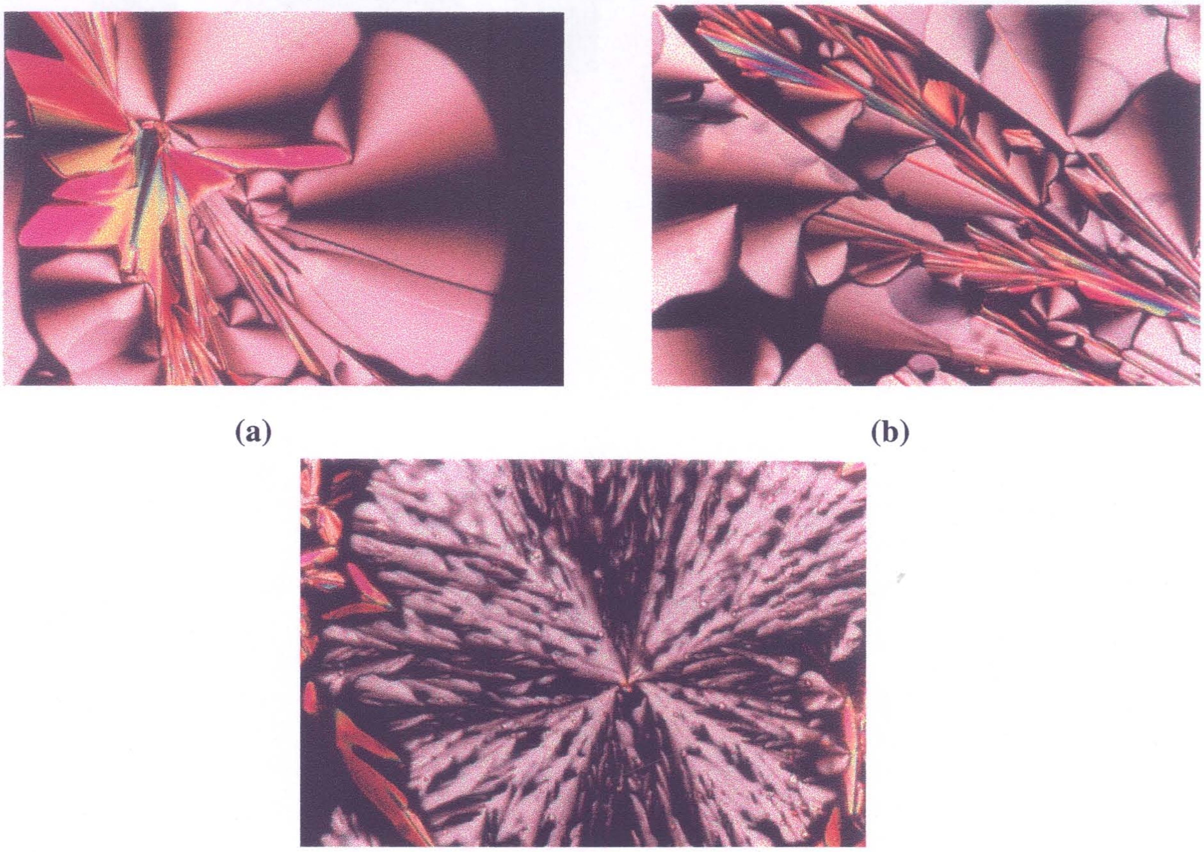
It has already been shown that substitution by fluorine in symmetrical positions *ortho* to n-alkoxy chain resulted in new banana phases, which are ferroelectric in nature [23, 31, 51, 53, 73]. It was therefore envisaged to synthesize compounds with only one fluorine in the same *ortho* position for comparison. The transition temperatures and the associated enthalpy values for these new unsymmetrical compounds are summarized in table **7.2.**

Table 7.2: Transition temperatures (°C) and the associated enthalpies (kJ mol^{-1}) for the unsymmetrical compounds of series 7.11



Compound	n	Cr		B2		B1		I
7.B.1	6	.	103.0 *35.7*	-		.	109.0 *17.5*	.
7.B.2	7	.	101.5[a] *30.4*	.	112.0 *19.4*	-		.
7.B.3	8	.	102.0[a] *30.7*	.	116.0 *20.5*	-		.
7.B.4	9	.	103.0[a] *25.0*	.	118.5 *21.0*	-		.
7.B.5	10	.	105.5 *22.9*	.	120.0 *21.8*	-		.
7.B.6	11	.	108.0 *25.4*	.	121.5 *22.4*	-		.
7.B.7	12	.	110.0[a] *28.2*	.	122.5 *22.3*	-		.
7.B.8	14	.	106.0 *25.0*	.	123.5 *23.2*	-		.
7.B.9	16	.	100.0 *22.1*	.	123.0 *23.5*	-		.
7.B.10	18	.	99.0 *23.4*	.	123.5 *23.1*	-		.

As can be seen, two types of mesophases were observed. When a sample of compound **7.B.1** was cooled from the isotropic phase, spherulitic pattern could be seen to grow and sometimes fern-like texture also developed. Some typical variants of the texture obtained are shown in figure **7.9** and such textures have been seen earlier [31, 32, 109]. On increasing the chain length further, B_2 phase was obtained which was characterized by polarized light microscopy, XRD studies and electro-optical investigations.


(a) **(b)**

(c)

Figure 7.9 (a), (b) and (c): Photomicrographs of different textures obtained for B_1 phase of compound 7.B.1.

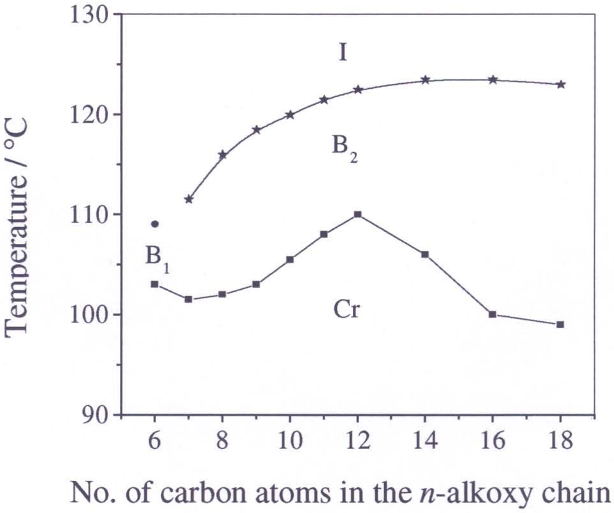


Figure 7.10: A plot of transition temperatures as a function of the number of carbon atoms in the *n*-alkoxy chain for compounds of series 7.II.

A plot of transition temperatures as a function of alkyl chain length for this homologous series is shown in figure 7.10. The clearing temperatures for the B_2 phase show the typical smooth curve for such a transition along a homologous series of compounds.

To confirm the nature of B_1 and B_2 mesophases, XRD studies were carried out. Compound 7.B.1, which is isomeric with compound 7.A.1, showed the following XRD data. Three reflections in the small angle region at d_1=30.6Å, d_2=20.0Å and d_3=15.5Å. were obtained. The measured molecular length was 50.1Å by assuming the methylene units of *n*-alkoxy chain in a fully extended all ***trans*** conformation. This means that 30.6Å can be excluded as a reflection due to half molecular length. If one assumes the reflection at 20.0Å as (02) plane, then reflections at 30.6Å and 15.5Å can be indexed to (11) and (22) planes respectively. The calculated lattice parameters were a=47.5 and b=40. This would mean that the mesophase is B_1 with a large tilt of the molecules (tilt angle 37°). Similar XRD patterns [32] and optical textures [31,109] have been observed for the B_1 phase in different systems. Compound 7.B.5, which is isomeric with compound 7.A.5 also, showed three reflections in the small angle region at d_1=36.9Å, d_2=18.5Å, and d_3=12.3Å which are again in the ratio of 1:1/2:1/3. It can be seen that the d-spacings obtained for the *ortho* fluoro substituted compound (compound 7.B.5) is larger than that of isomeric ***meta*** fluoro substituted compound (compound 7.A.5) which suggests that the n-alkoxy chain conformation in the two systems are different.

The electric field experiments were carried out for the mesophase of compounds 7.B.5 and 7.B.10. Compound 7.B.5 was taken in a ITO coated cell for homogeneous alignment of the sample of thickness 11.1μm. The sample was cooled very slowly from the isotropic phase. On applying a triangular-wave electric field of $290V_{pp}$ at 20Hz, two polarization current peaks per half cycle were obtained indicating an antiferroelectric ground state for the mesophase. A typical switching current response obtained is shown in figure 7.11.

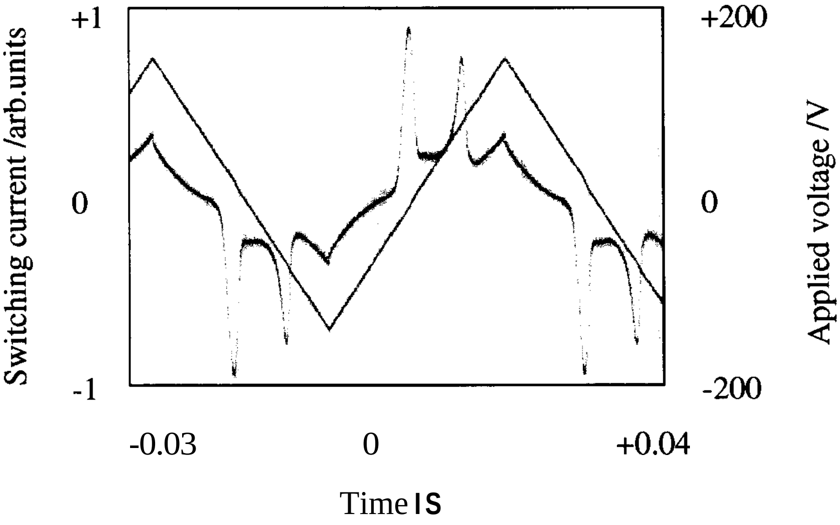


Figure 7.11: Switching current response trace obtained for the mesophase of compound 7.B.5 by applying a triangular-wave electric field **(290V$_{pp}$, 20Hz)**; cell thickness: **11.1μm;** the saturated polarization value ≈ 615 **nC cm^{-2}.**

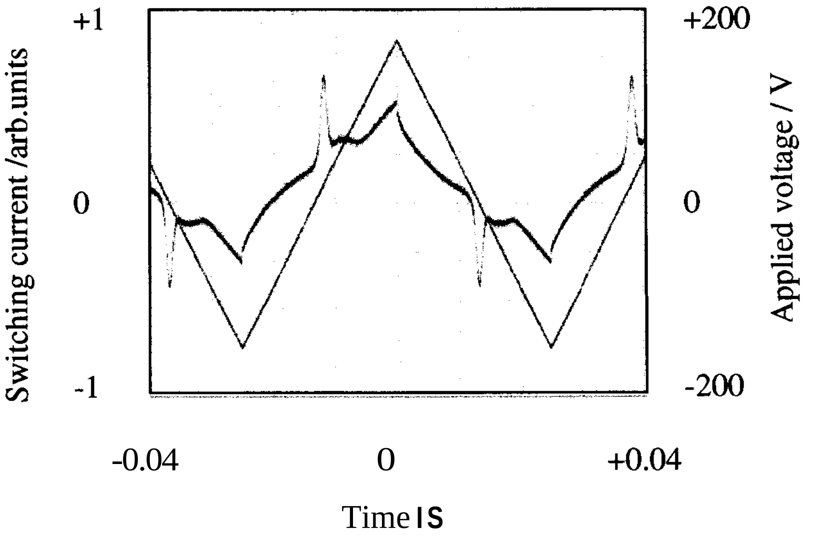


Figure 7.12: Switching current response trace obtained for the mesophase of compound 7.B.10 by applying a triangular-wave electric field **(320V$_{pp}$, 20Hz)**; cell thickness: **14.1μm;** the saturated polarization ≈ 120 **nC cm^{-2}.**

Interestingly in the triangular-wave electric field experiments, the mesophase of compound **7.B.10** showed only one polarization current peak per half cycle suggesting a ferroelectric ground state. The current response trace obtained is shown in figure **7.12.** Although such a behaviour has been observed in a number of other systems, the ground state structure is not ferroelectric. In order to confirm the ground state structure, we employed modified triangular-wave electric field experiments in which a simple triangular voltage –V to +V is modified such that there is ample time for the switching to be complete between the two polarized states and the polarized states are stable when the field is switched off. The current response curve obtained under these conditions is shown in figure **7.13.** The two polarization current peaks per half cycle in the modified triangular-wave clearly indicate an antiferroelectric ground state for the mesophase.

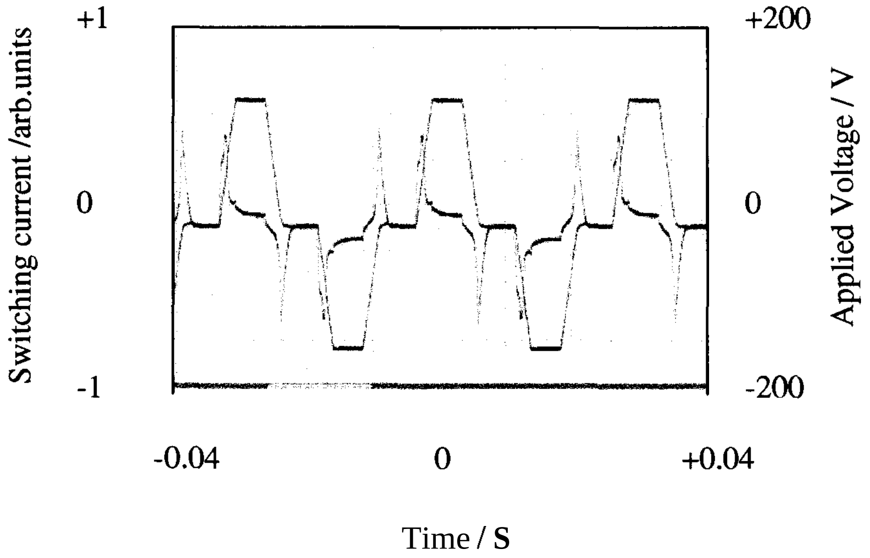
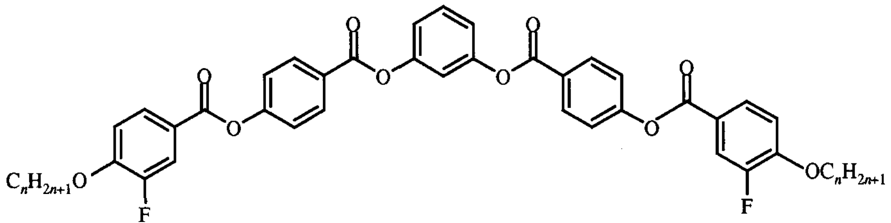


Figure 7.13: Switching current response trace obtained for the mesophase of compound 7.B.10 by applying a modified triangular- wave electric field (280V_{pp}, 33Hz); cell thickness: 11.3μm; the saturated polarization ≈ 580 nC cm^{-2}.

A comparison of the mesomorphic behaviour of these unsymmetrical compounds with those of the symmetrical compounds reported earlier [51, 58] revealed some interesting observations. The general structure of the symmetrical compounds is shown in structure B, which has a fluorine substituent *ortho* to the terminal n-alkoxy chain in both the arms. It was demonstrated earlier [51, 58] that depending on the terminal chain length, both lamellar as well as two-dimensional ferroelectric phases can be obtained from such compounds. In contrast, however, the analogous unsymmetrical compounds exhibit only the antiferroelectric B_2 phase.



Structure B

Compounds belonging to series **7.1** and series **7.11** are isomeric and differ only by the position of the fluorine substituent. A comparison between the two series of compounds revealed the following points. In the former case the melting points are lower and hence the thermal range of the mesophase for the higher homologues is larger. In series **7.1** the lower homologues show the normal **B_1** phase, while in series **7.11** one compound shows **B_1** phase for which X-ray pattern and textures are slightly different (tilt angle is more). The compounds having longer n-alkoxy chain in both the series show a B_2 mesophase. A comparative plot of transition temperatures Vs number of carbon atoms in the n-alkoxy chain for compounds of series **7.1** and **7.11** is shown in figure **7.14.**

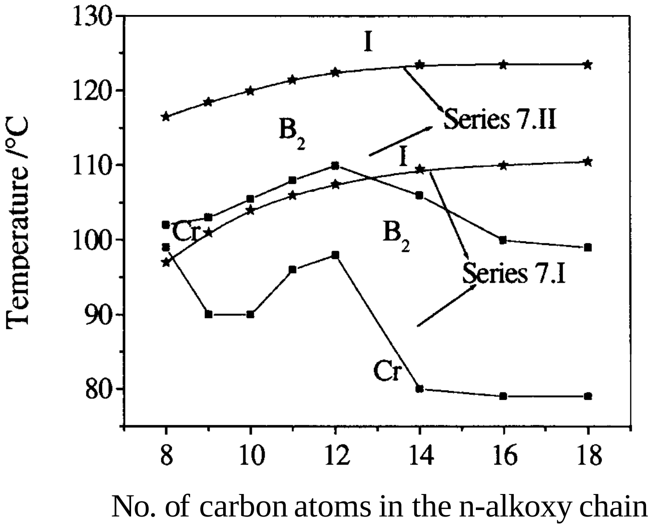


Figure 7.14: A comparative plot of transition temperatures as a function of the number of carbon atoms for compounds of series 7.1 and series 7.11. The effect of the position of fluorine substituent can be clearly seen.

The transition temperatures together with the enthalpy data as determined from DSC thermograms for compounds of series **7.III** are collected in table **7.3**. Two types of mesophases were observed in this homologous series of compounds. The mesophases of compounds **7.C.1** and **7.C.2** are monotropic and when observed under a polarizing microscope exhibited similar optical textures upon cooling from the isotropic liquid. The growth of mosaic or spherulitic texture clearly indicated that the mesophase is a two-dimensional columnar B_1 phase. A typical texture developing from the isotropic liquid of compound **7.C.1** is shown in figure **7.15**. The mesophase of compound **7.C.1** gave two reflections in the small angle region at d_1 =25.5Å and d_2=20.8 Å. This can be indexed to (11) and (02) reflections of a rectangular lattice.

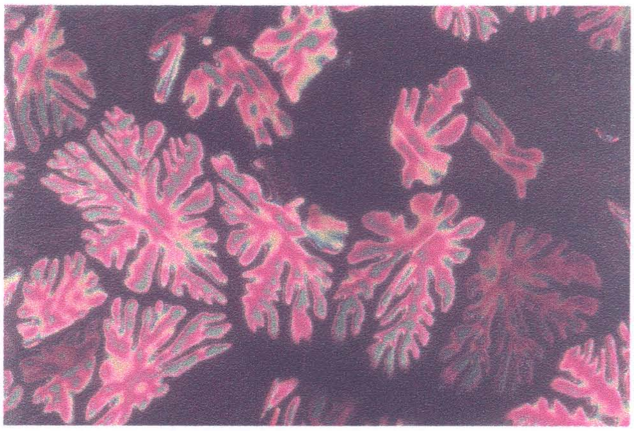
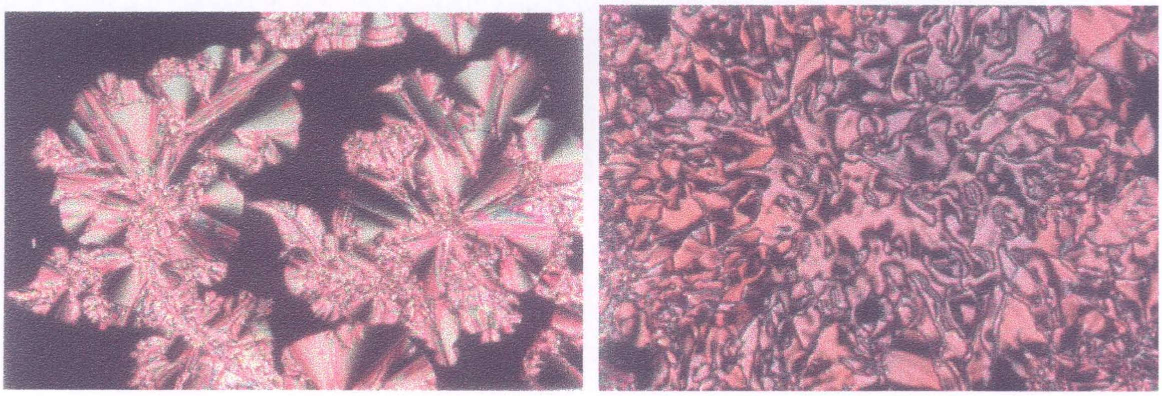


Figure 7.15: An optical photomicrograph of the B_1 mesophase appearing from the isotropic phaseof compound 7.C.1.

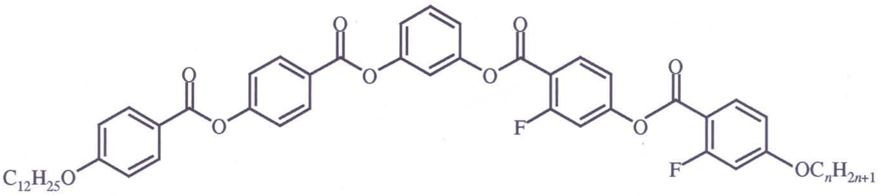
When the length of one of the arms was increased by a methylene unit, compound **7.C.3** was obtained. This compound was also monotropic but exhibited a fringe pattern or a schlieren texture on cooling the isotropic liquid. Compounds **7.C.4-7.C.10** also showed similar optical textures. Typical textures obtained for the mesophase of compound **7.C.5** are shown in figure **7.16 (a)** and **7.16 (b)**. These textures suggest that the mesophase could be a lamellar B_2 phase.



(a) (b)

Figure 7.16 (a) and (b): Optical photomicrographs obtained for the B$_2$ mesophase of compound 7.C.5.

Table 7.3: Transition temperatures (°C) and the associated enthalpies (kJ mol^{-1}) for the unsymmetrical compounds of series 7.III



Compound	*n*	Cr		B$_2$		B$_1$		I
7.C.1	6	.	97.5 *53.6*	-		(.	87.0) *13.5*	.
7.C.2	7	.	97.0 *60.6*	-		(.	86.0) *14.6*	.
7.C.3	8	.	97.0^a *61.2*	(.	90.5) *18.5*	-		.
7.C.4	9	.	98.0^a *73.9*	(.	94.0) *19.2*	-		.
7.C.5	10	.	87.0^a *29.5*	.	97.0 *20.2*	-		.
7.C.6	11	.	90.0^a *33.2*	.	99.5 *21.2*	-		.
7.C.7	12	.	91.0 *38.6*	.	101.5 *20.9*	-		.
7.C.8	14	.	86.0 *56.5*	.	104.0 *22.5*	-		.
7.C.9	16	.	86.0^a *53.4*	.	105.0 *23.0*	-		.
7.C.10	18	.	93.0 *56.4*	.	106.0 *23.6*	-		.

To confirm the mesophase structure of the B_2 mesophase, X-ray diffraction studies on representative compounds of this series was carried out. The d-values obtained in the small angle region for compounds **7.C.5** and **7.C.10** indicated that the mesophase is smectic. The d-spacings obtained for these compounds are given in table **7.7.**

To confirm the antiferroelectric nature of the B_2 phase of compounds of series **7.111** triangular-wave electric field experiments were carried out. For example, a sample of compound **7.C.5** was filled into a cell in the isotropic phase and cooled slowly from this phase under a triangular-wave electric field. When the voltage was above the threshold, two polarization current peaks per half cycle were observed. Figure **7.17** shows the switching current response obtained for the mesophase of compound **7.C.5** at a voltage of $184V_{pp}$ at 40 Hz. From these triangular-wave experiments, one can infer that the mesophase has an antiferroelectric ground state, which is a typical feature of the B_2 phase.

To study the tilt sense in the antiferroelectric B_2 phase, dc field experiments were carried out. A sample of compound **7.C.5** was taken in a cell treated for homogeneous alignment of the sample of thickness 10 µm and cooled slowly from the isotropic phase under a dc voltage of 5V μm^{-1}. Circular domains which make an angle w.r.t. the analyzer were obtained which indicates a synclinic tilt of the molecules in a field induced state. When the polarity of the applied field was reversed the orientation of the brushes rotate in an anticlockwise direction and the mesophase goes to another ferroelectric state. However, when the field was switched off, the brushes rotate along the analyzer direction. This indicates that the compound has a SmC_AP_A ground state structure, and on applying a dc field goes over to one of the SmC_SP_F structures. Optical photomicrographs obtained under these conditions are shown in figure **7.18.**

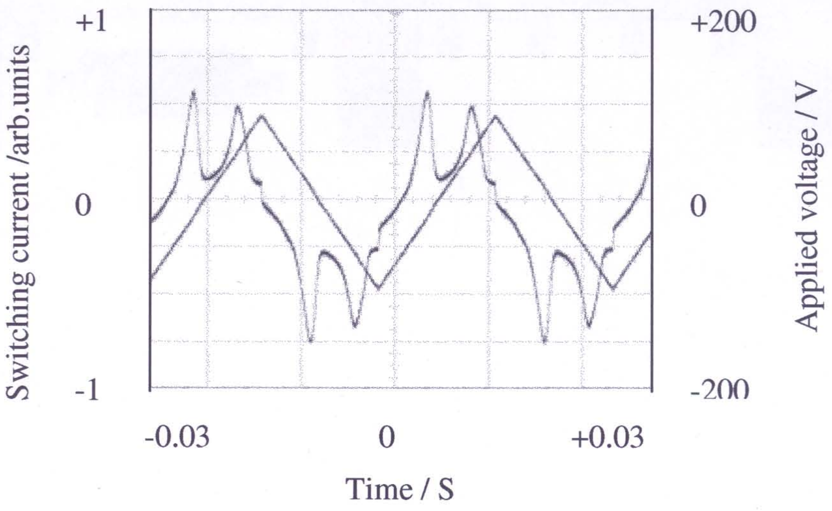
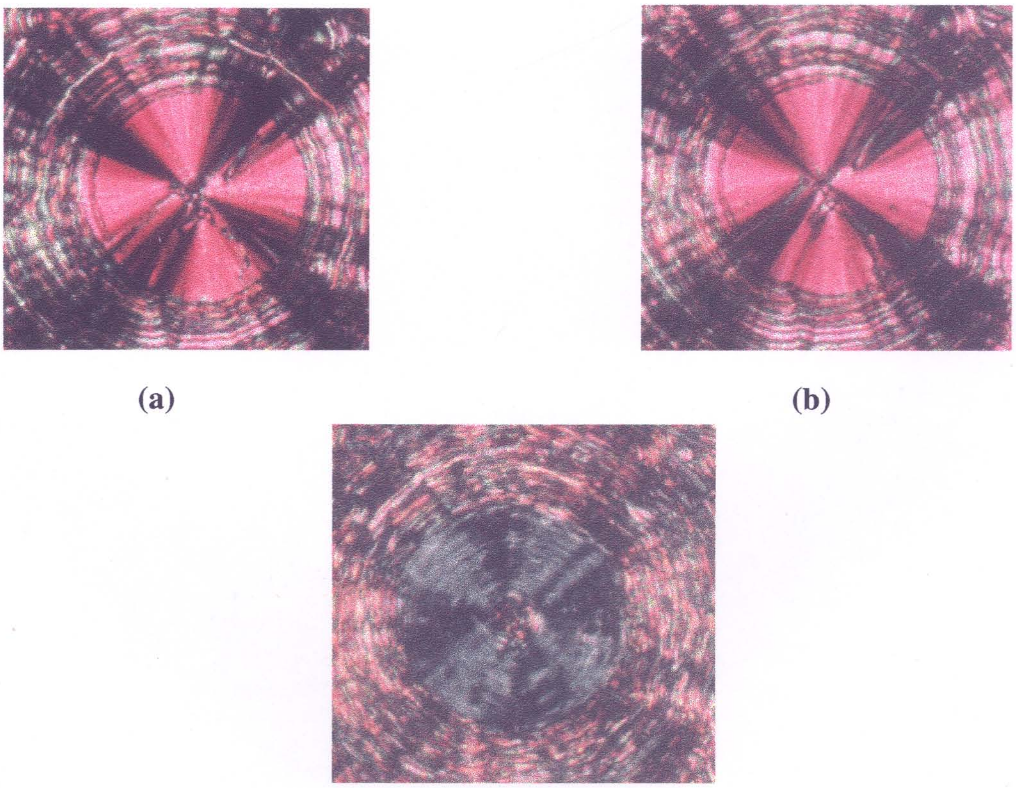


Figure 7.17: Switching current response obtained for the mesophase of compound 7.C.5 by applying a triangular-wave electric field (184V$_{pp}$, 40Hz); cell thickness 10.8μm the saturated polarization value ≈ 585 nC cm^{-2}.



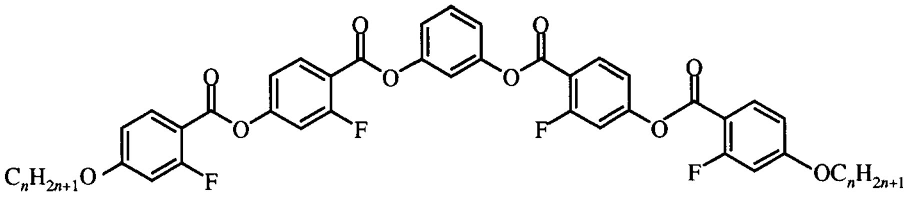
(a)

(b)

(c)

Figure 7.18: Optical photomicrographs showing the effect of dc field; (a) – 5 Vμm^{-1}; (b) + 5 V μm $^{-1}$; (c) 0V; the rotation of brushes indicates the anticlinic tilt of the molecules in the B_2 (SmC_AP_A) phase; compound 7.C.5.

The influence of a lateral fluorine substituent on the mesomorphic properties of symmetrical five-ring esters derived from resorcinol was reported earlier [58]. **A** comparison of the properties exhibited by the unsymmetrical compounds belonging to series **7.111** with those of the symmetrical compounds (Structure **C)** indicates the following. In both the symmetrical as well as the unsymmetrical compounds, B_1 and B_2 phases have been observed. However, the unsymmetrical compounds have lower melting points as a result of which the thermal range of the mesophases are more.



Structure **C**

The compounds, which have fluorine at the *ortho* position w.r.t the n-alkoxy chain, exhibited interesting mesophase behaviour particularly compounds with longer alkoxy chain. With this in view, several compounds were synthesized in which fluorine substitution was effected in only one of the arms of the bent-core compounds.

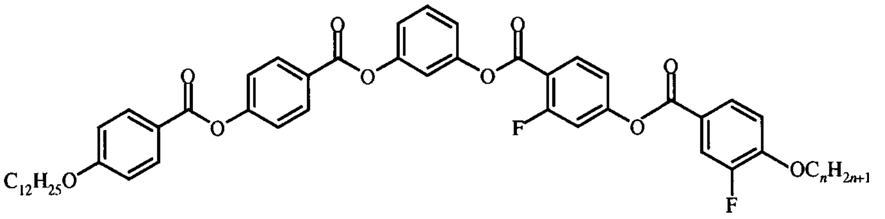
The transition temperatures and the associated enthalpies for the homologues of series **7.IV** are summarized in table **7.4.** These contain a fluorine *ortho* to the terminal n-alkoxy chain and another fluorine *ortho* to the carboxylate group of the middle phenyl ring.

Compound **7.D.1** is non-mesomorphic while compounds **7.D.2-7.D.10** showed enantiotropic B_2 phase. It can be seen from tables **7.3** and **7.4** that the clearing temperatures of compounds of series **7.IV** are enhanced by 13-20°C, with a marginal increase in the melting points. Thus, shifting the fluorine substituent from ***meta*** to *ortho* position w.r.t. the terminal n-alkoxy chain has resulted in a fairly large thermal range for the B_2 mesophase.

The B_2 phase structure of the compounds of this series are confirmed from XRD studies. The d-values obtained for compounds **7.D.5** and **7.D.10** which are isomeric with compounds **7.C.5** and **7.C.10** (series **7.111)** are somewhat interesting. The d-spacings of compounds **7.D.5** and **7.D.10** are larger by 3 to 5Å as compared to the isomeric compounds. This is due to the presence of fluorine, which is *ortho* to the n-alkoxy chain, which has an influence on the conformation of the n-alkoxy chain.

Since a fluorine substituent *ortho* to the n-alkoxy chain resulted in symmetrical compounds showing ferroelectric mesophases, detailed electro-optical experiments on compounds of series **7.IV** were carried out. **A** sample of compound **7.D.10** was taken in a cell treated for homogeneous alignment of the sample of thickness 12.8μm. On applying a voltage of 292V_{pp} at 8 Hz, two polarization current peaks per half cycle were observed indicating an antiferroelectric ground state. Thus, unlike in symmetrical *ortho* substituted compounds, the unsymmetrical compounds showed an antiferroelectric behaviour. **A** typical switching current response obtained for compound **7.D.10** is shown in figure **7.19.**

Table 7.4: Transition temperatures (°C) and the associated enthalpies (kJ mol^{-1}) for the unsymmetrical compounds of series 7.IV



Compound	n	Cr		B2		I
7.D.1	6	.	101.0 *40.5*	-		
7.D.2	7	.	101.0 *30.4*	.	106.0 *19.7*	
7.D.3	8	.	100.5[a] *34.0*	.	110.0 *20.9*	
7.D.4	9	.	101.0[a] *28.9*	.	112.5 *21.0*	
7.D.5	10	.	100.0[a] *28.9*	.	114.5 *22.2*	
7.D.6	11	.	99.5[a] *20.1*	.	116.0 *22.6*	
7.D.7	12	.	97.0[a] *62.3*	.	117.5 *22.8*	
7.D.8	14	.	95.0[a] *43.2*	.	119.0 *24.1*	
7.D.9	16	.	94.0[a] *47.0*	.	119.5 *24.0*	
7.D.10	18	.	93.0[a] *52.1*	.	119.5 *23.8*	

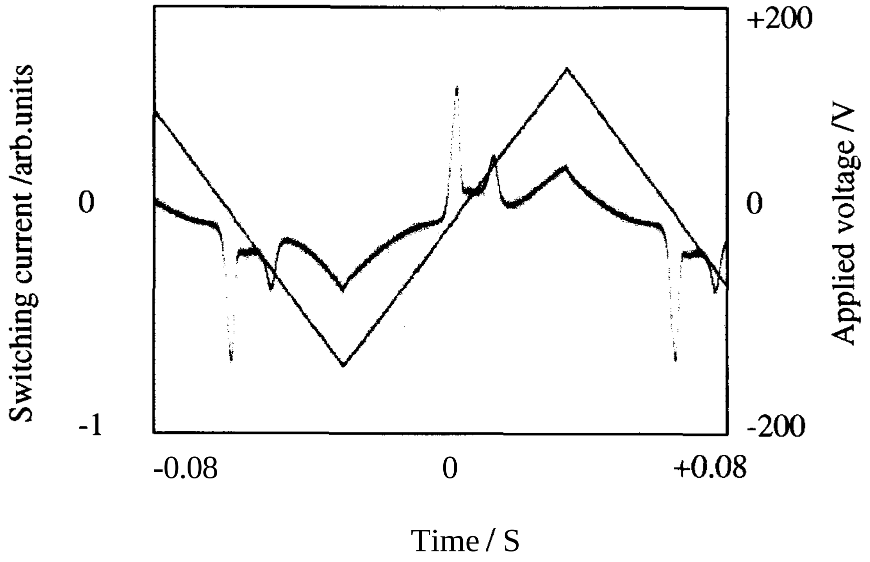
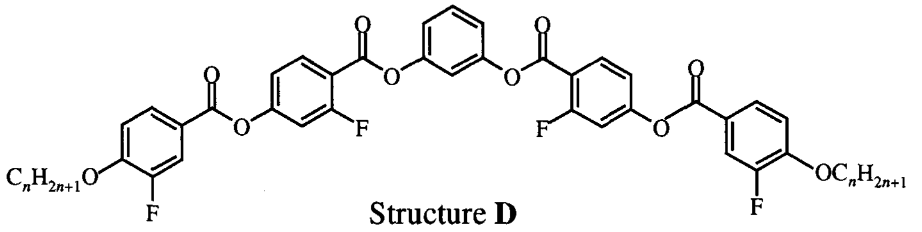


Figure 7.19: Switching current response obtained for the mesophase of compound 7.D.10 by applying a triangular-wave electric field (292V$_{pp}$, 8Hz); cell thickness 12.8μm; the saturated polarization value ≈ 605 nC cm^{-2}.

Again, comparing the mesomorphic properties of the compounds of series **7.IV** with those of the symmetrical compounds (Structure **D**) already reported [58] it can be inferred that the higher homologues of the latter exhibit ferroelectric properties while the corresponding unsymmetrical compounds are antiferroelectric in nature. Thus, the position and the number of fluorine substituents play an important role in inducing ferro- /antiferro-electric properties in these five-ring bent-core compounds.



Structure D

Incidentally, a comparison of the melting and clearing temperatures for the compounds of series **7.111** and **7.IV** which exhibit the B_2 phase can be made and a plot of these is shown in figure **7.20.** It can be seen that the thermal range of the B_2 phase is wider for compounds of series **7.IV** and all these compounds exhibit an enantiotropic B_2 phase.

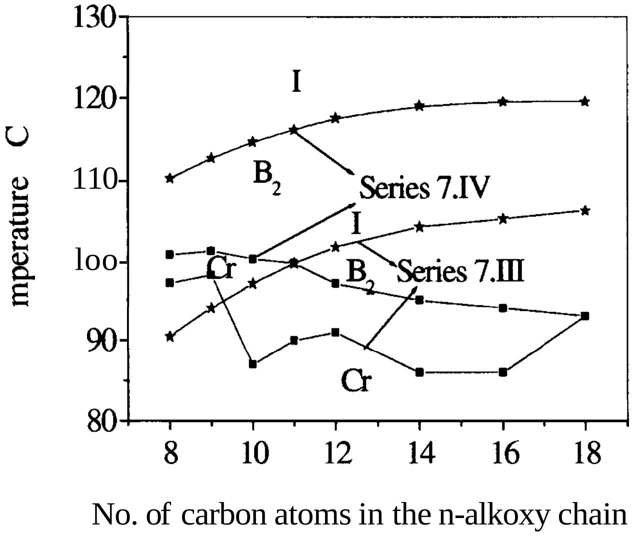
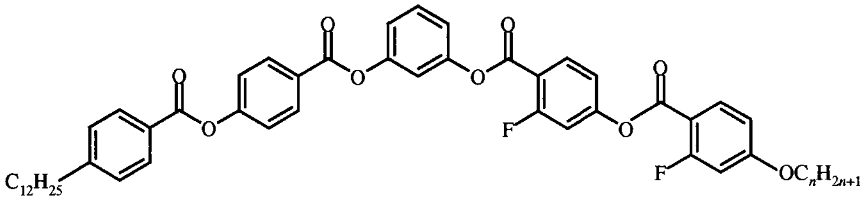


Figure 7.20: A comparative plot of transition temperatures as a function of the number of carbon atoms of in the n-alkoxy chain for compounds series 7.111 and series 7.IV, B_2 phase.

It is quite well established now, that compounds containing an n-alkyl chain have lower transition temperatures than their n-alkoxy analogues. Bent-core compounds containing an n-alkyl chain are few in number. In order to see the effect of replacing the n-alkoxy chain present in compounds of series **7.111** and series **7.IV** by an n-alkyl chain, two more homologous series of compounds (series **7.V** and **7.VI**) were prepared.

The transition temperatures and the associated enthalpy values for the compounds of series **7.V** are summarized in table **7.5.** In general, the mesophase behaviour remains unchanged when compared to compounds of series **7.111.** Only one compound (compound **7.E.1**) showed B_1 phase and the remaining compounds in the homologous series showed a B_2 phase. As expected, the n-alkyl analogues have lower melting points and hence a large thermal range for the B_2 mesophase. The structure of the B_2 phase was confirmed from XRD studies on representative compounds. The d-values obtained for compounds **7.E.1** and **7.E.10** confirm the B_1 and B_2 mesophase structures respectively and the d-values are given in table **7.7.**

Table 7.5: Transition temperatures (°C) and the associated enthalpies (kJ mol^{-1}) for the unsymmetrical compounds series 7.V



Compound	n	Cr		B_2		B_1		I
7.E.1	6	.	90.0	-		(.	82.0)	.
			47.1				*13.7*	
7.E.2	7	.	88.0	(.	85.0)	-		.
			47.7		*17.3*			
7.E.3	8	.	77.0	.	90.0	-		.
			15.3		*18.6*			
7.E.4	9	.	84.0	.	93.5	-		.
			36.3		*19.5*			
7.E.5	10	.	89.5	.	97.0	-		.
			41.6		*20.1*			
7.E.6	11	.	73.5	.	99.0	-		.
			25.7		*20.8*			
7.E.7	12	.	72.0	.	100.0	-		.
			24.3		*21.3*			
7.E.8	14	.	73.5	.	102.0	-		.
			43.5		*22.0*			
7.E.9	16	.	69.0	.	103.0	-		.
			35.3		*23.2*			
7.E.10	18	.	72.5	.	103.5	-		.
			45.6		*23.9*			

The antiferroelectric behaviour of the B_2 phase was confirmed by the triangular-wave experiments on one of the compounds in the homologous series. A typical switching current response trace obtained for the mesophase of compound **7.E.10** is shown in figure **7.21.**

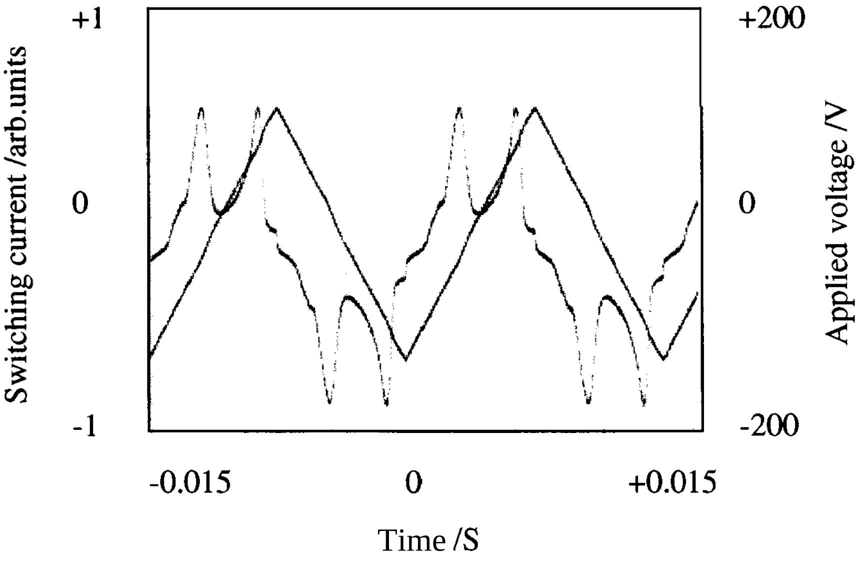


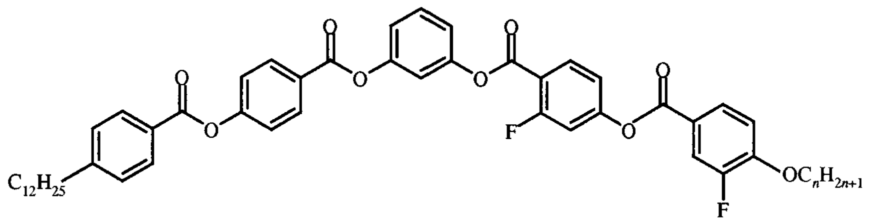
Figure 7.21: **Switching current response obtained for the mesophase of compound** 7.E.10 **by applying a triangular-wave electric field ($233V_{pp}$, 65Hz); cell thickness 9.2μm; the saturated polarization value** ≈ 532 **nC cm".**

The compounds of series **7.VI**, which are the n-alkyl analogues of compounds of series **7.IV**, show similar phase behaviour. The transition temperatures and the associated enthalpies for compounds of series **7.VI** are summarized in table 7.6. Except for compound 7.F.1, which is non-mesomorphic, the remaining homologues exhibit an enantiotropic B_2 phase. In this series also, there is a reduction of temperature in both the melting and clearing points as compared to those of series **7.IV**.

The mesophase structure was confirmed from XRD studies. The d-values obtained for compounds 7.F.2 and 7.F.10 can be compared to those of the isomeric compounds (7.E.2 and 7.E.10). Comparing the d-values, one can see a larger d-spacing for the compounds, which have fluorine in the *ortho* position w.r.t to the n-alkoxy chain. The d-spacings obtained are given in table 7.7.

Thus, from XRD studies one can clearly say that the compounds of series 7.1, 7.111 and 7.V exhibiting a smectic phase have different n-alkoxy chain conformation as compared to their isomeric analogues of series **7.II**, **7.IV** and **7.VI**.

Table 7.6: Transition temperatures (°C) and the associated enthalpies (kJ mol^{-1}) for the unsymmetrical compounds of series 7.VI



Compound	*n*	Cr		B_2		I
7.F.1	6	.	103.0	-		.
			41.0			
7.F.2	7	.	98.5	.	104.0	.
			21.5		*19.6*	
7.F.3	8	.	97.5	.	108.0	.
			21.3		*20.7*	
7.F.4	9	.	96.0^a	.	110.5	.
			40.1		*20.8*	
7.F.5	10	.	95.0^a	.	112.5	.
			43.9		*22.1*	
7.F.6	11	.	94.0^a	.	113.5	.
			63.4		*22.9*	
7.F.7	12	.	94.0^a	.	114.5	.
			50.5		*22.9*	
7.F.8	14	.	90.0^a	.	115.0	.
			55.1		*23.5*	
7.F.9	16	.	87.0	.	115.5	.
			14.8		*23.6*	
7.F.10	18	.	82.0	.	115.5	.
			71.5		*24.0*	

The d-values obtained for different mesophases of representative compounds belonging to the six homologous series which are under investigation are given in table **7.7.**

Table 7.7: The d values obtained from XRD studies for the mesophase of different compounds belonging to series 7.1 series 7.VI and their Miller indices

Compound	d values / Å d_1	 d_2	 d_3	Phase type
7.A.1	26.2 (11)	21.6 (02)	-	B_1
7.A.5	34.0 (01)	17.0 (02)	11.3 (03)	B_2
7.A.10	38.6 (01)	19.3 (02)	12.9 (03)	B_2
7.B.1	30.6 (11)	20.0 (02)	15.5 (22)	B_1
7.B.5	36.9 (01)	18.5 (02)	12.3 (03)	B_2
7.C.1	25.5 (11)	20.8 (02)	-	B_1
7.C.5	33.1 (01)	16.5 (02)	11.0 (03)	B_2
7.C.10	38.2 (01)	-	12.7 (03)	B_2
7.D.5	37.8 (01)	18.9 (02)	9.5 (04)	B_2
7.D.10	41.3 (01)	-	13.8(03)	B_2
7.E.2	31.6 (01)	15.8 (02)	-	B_2
7.E.10	37.5 (01)	-	12.5 (03)	B_2
7.F.2	36.2 (01)	18.1(02)	-	B_2
7.F.10	41.3 (01)	-	13.8 (03)	B_2

The switching current response obtained for compound **7.F.10** is shown in figure **7.22.** From this figure it is very clear that compound **7.F.10** has an antiferroelectric ground state structure.

Thus, the unsymmetrical compounds with fluorine at *ortho* position w.r.t. the n-alkoxy chain showed antiferroelectric behaviour in contrast to the symmetrical compounds.

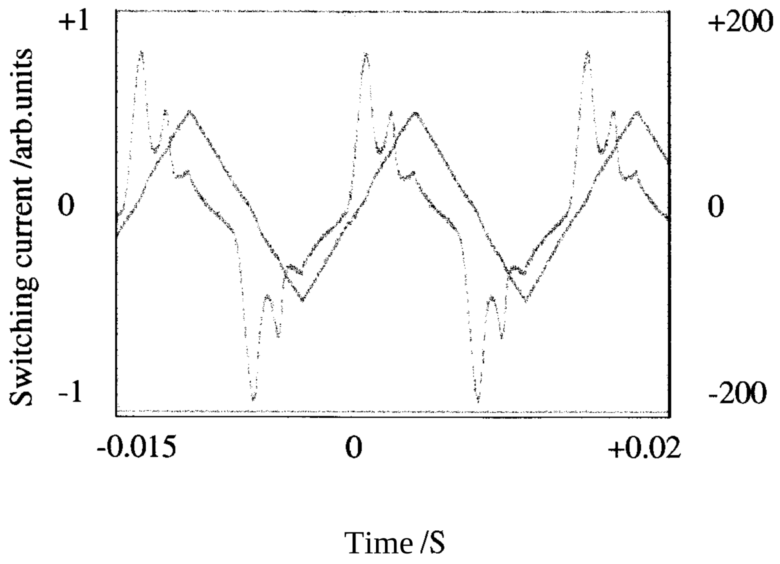


Figure 7.22: Switching current response obtained for the mesophase of compound 7.F.10 by applying a triangular-wave electric field (191 $\mathbf{V_{pp}}$, **70Hz,)**; cell thickness **13.8μm** the saturated polarization value ≈ **550nC** $\mathbf{cm^{-2}}$.

A comparison of the transition temperatures of compounds exhibiting the B_2 phase for these two series 7.V and **7.VI** is shown in figure 7.23. It is clear from this figure that the ***meta*** fluoro substituted (w.r.t n-alkoxy chain) compounds of series 7.V have lower transition temperatures.

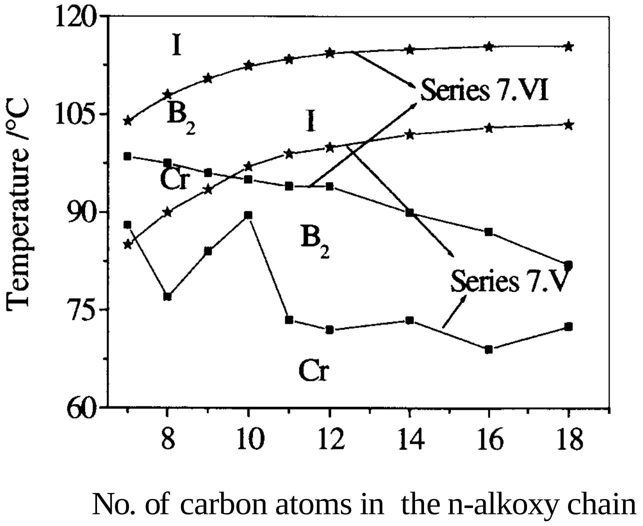


Figure 7.23: A comparative plot of the transition temperatures as a function of the number of carbon atoms in the n-alkoxy chain for compounds of series 7.V and **7.VI,** B_2 phase.

Summary

A systematic study of the mesomorphic properties of unsymmetrical compounds containing a lateral fluorine substituent was carried out. Sixty compounds belonging to six different homologous series were studied. The occurrence of a transition from B_1 to B_2 phase, which is rather rare, was substantiated with textural features and DSC thermogram. The unsymmetrical compounds with only one fluorine substituent *ortho* to n-alkoxy chain showed an antiferroelectric B_2 phase even for long chain lengths. This is in contrast to the symmetrical compounds (with two *ortho* fluorine substituents) which exhibit ferroelectric properties. The position and number of fluorine substituents play a role in inducing the ferro-/antiferro-electric mesophases in these five-ring bent-core achiral compounds. A comparison of the d-spacings of the B_2 phase exhibited by the compounds of series **7.I**, **7.III** and **7.V** and their isomeric analogues of series **7.II**, **7.IV** and **7.VI** show that the conformation of the n-alkoxy chain in the two sets of compounds are different. As expected terminal n-alkyl chain substituted compounds have lower transition temperatures than their n-alkoxy counterparts.

Experimental

4-n-Dodecyloxybenzioc acid 7.i ($R=n\text{-}C_{12}H_{25}O$) was prepared according to a procedure described in the literature [63]. 4-n-Dodecybenzioc acid, 7.i ($R=n\text{-}C_{12}H_{25}$) was prepared according to similar procedure that described in the literature using benzene as starting material [70]. Benzyl-4-hydoxybenzoate, **7.ii** and resorcinol were commercial compounds and used without further purification. 3-Benzyloxyphenol, **7.iii** was synthesized following a procedure described in the literature [104]. 4-Benzyloxybenzoic acid, **7.iv**, (X=H) [59], **2-fluoro-4-benzyloxybenzoic** acid, **7.iv**, (X=F) [59-61], 2-fluoro- and 3-fluoro-4-*n*-alkoxybenzoic acids **7.v**, (Y=F, Z=H and Y=H, Z=F respectively) [61, 63] were prepared according to the procedures reported in the literature. The physical data for 2-fluoro- and 3-fluoro-4-n-alkoxybenzoic acids are given in the tables 7.8 and 7.9 respectively.

Table 7.8: The physical data **of** the 2-fluoro-4-n-alkoxybenzoic acids.

No.	n	Observed m.p. (^oC)	Reported m.p. (^oC)	Reference
1	6	109.0	108.0	[61]
2	7	94.0	-	-
3	8	94.5		-
4	9	87.5		-
5	10	94.0		-
6	11	90.0		-
7	12	98.0		-
8	14	96.0		-
9	16	99.0	99.0	[110]
10	18	100.0	99.5	[110]

Table 7.9: The physical data 3-fluoro-4-n-alkoxy benzoic acids

No.	*n*	Observed m.p. (°C)	Reported m.p. (°C) [63]
1	6	130.0	129.5
2	7	124.0	124.0
3	8	118.0	117.0
4	9	112.5	112.0
5	10	109.0	108.0
6	11	113.5	-
7	12	109.0	108.5
8	14	113.0	-
9	16	114.5	94.0
10	18	114-115	114.0

The physical data of the compounds **7.a** to **7.f** are given in the Chapter *6*.

1-(2-Fluoro-4-*n*-hexyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxy-benzoyloxy-4-benzoate), 7.A.1

A mixture of compound **7.f** (0.150g, 0.24mmol), 2-fluoro-4-n-hexyloxybenzoic acid, **7.v** Y=F, Z=H, *n*=6, (0.058g, 0.24mmol) catalytic amount of 4-(N, N-dimethylamino) pyridine (DMAP), and dry dichloromethane (10ml) were stirred for ten min. To this N, N'-dicyclohexylcarbodiimide (DCC), (0.065g, 0.026mmol) was added and stirred overnight. The precipitated N, N'-dicyclohexylurea was filtered off and washed with dichloromethane (10ml). The filtrate was washed successively with 5% aqueous acetic acid (2 x 10ml), 5% ice-cold sodium hydroxide solution, (2 x 10 ml), water (3 x 15 ml) and dried over anhydrous sodium sulphate. The solvent was removed to yield a product, which was purified by column chromatography on silica gel using chloroform as eluent. Removal of solvent from the eluate gave a white material, which was crystallized from a mixture of chloroform and acetonitrile.

Yield, 76%; m.p. 99.0°C; ν_{max}: 3072,2922,2853, 1757, 1734, 1717, 1603, 1254, 1161, 1061 cm^{-1}; δ_H: 8.29-8.27 (d, 4H, ^{3}J8.4Hz, Ar-H), 8.16-8.14 (d, 2H, ^{3}J8.88Hz, Ar-H), 8.08-8.03 (t, 1H, ^{3}J8.64Hz, Ar-H), 7.52-7.48 (t, 1H, ^{3}J8.4Hz, Ar-H), 7.40-7.36 (m, 4H, Ar-H), 7.21-7.17 (m, 3H, Ar-H), 7.0-6.98 (d, 2H, ^{3}J8.88Hz, Ar-H), 6.80-6.78 (dd, 1H, ^{3}J8.92Hz, ^{4}J2.12Hz, Ar-H), 6.72-6.68 (dd, 1H, ^{3}J12.72Hz, ^{4}J2.24Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^{3}J6.68Hz, 2 x Ar-O-CH_2-), 1.84-1.79 (m, 4H, 2 x Ar-O-CH_2-C$\underline{H}_2$-), 1.48-1.27 (m, 24H, 12 x -CH_2-), 0.90-0.87 (m, 6H, 2 x -CH_3).

1-(2-Fluoro-4-*n*-heptyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate), 7.A.2

Yield, 70%; m.p. 97.0°C; ν_{max}: 3071, 2922, 2853, 1736, 1724, 1603, 1256, 1161, 1059 cm^{-1}; δ_H: 8.29-8.27 (d, 4H, ^{3}J8.52Hz, Ar-H), 8.16-8.14 (d, 2H, ^{3}J8.8Hz, Ar-H), 8.08-8.03 (t, 1H, ^{3}J8.64Hz, Ar-H), 7.52-7.48 (t, 1H, ^{3}J8.28Hz, Ar-H), 7.40-7.36 (m, 4H, Ar-H), 7.20-7.17 (m, 3H, Ar-H), 7.0-6.98 (d, 2H, ^{3}J8.8Hz, Ar-H), 6.80-6.78 (dd, 1H, ^{3}J8.84Hz, ^{4}J2.2Hz, Ar-H), 6.72-6.68 (dd, 1H, ^{3}J12.72Hz, ^{4}J2.16Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^{3}J6.68Hz, 2 x Ar-O-CH_2-), 1.86-1.79 (m, 4H, 2 x Ar-O-CH_2-C$\underline{H}_2$-), 1.47-1.27 (m, 26H, 13 x -CH_2-), 0.90-0.87 (m, 6H, 2 x -CH_3).

1-(2-Fluoro-4-*n*-octyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate), 7.A.3

Yield, 65%; m.p. 99.0°C; ν_{max}: 3071,2922,2853, 1732,1603, 1256,1163,1059 cm^{-1}; δ_H: 8.29-8.27 (d, 4H, ^{3}J8.52Hz, Ar-H), 8.16-8.14 (d, 2H, ^{3}J8.84Hz, Ar-H), 8.08-8.03 (t, 1H, ^{3}J8.64Hz, Ar-H), 7.52-7.48 (t, 1H, ^{3}J8.4Hz, Ar-H), 7.40-7.36 (m, 4H, Ar-H), 7.21-7.17 (m, 3H, Ar-H), 7.0-6.98 (d, 2H, ^{3}J8.84Hz, Ar-H), 6.80-6.78 (dd, 1H, ^{3}J8.88Hz, ^{4}J2.28Hz, Ar-H), 6.72-6.68 (dd, 1H, ^{3}J12.76Hz, ^{4}J2.32Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^{3}J6.64Hz 2 x Ar-O-CH_2-), 1.86-1.79 (m, 4H, 2 x Ar-O-CH_2-C$\underline{H}_2$-), 1.47-1.27 (m, 28H, 14 x -CH_2-), 0.90-0.87 (m, 6H, 2 x -CH_3).

1-(2-Fluoro-4-*n*-nonyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate), 7.A.4

Yield, 71%; m.p. 90.0°C; ν_{max}: 3071, 2924, 2853, 1732, 1721, 1603, 1258, 1161, 1059 cm^{-1}; δ_H: 8.29-8.27 (d, 4H, ^{3}J8.48Hz, Ar-H), 8.16-8.14 (d, 2H, ^{3}J8.84Hz, Ar-H), 8.08-

8.03 (t, 1H, ^{3}J8.64Hz, Ar-H), 7.52-7.48 (t, 1H, ^{3}J8.36Hz, Ar-H), 7.40-7.36 (m, 4H, Ar-H), 7.20-7.17 (m, 3H, Ar-H), 7.0-6.98 (d, 2H, ^{3}J8.84Hz, Ar-H), 6.80-6.78 (dd, 1H, ^{3}J8.88Hz, ^{4}J2.16Hz, Ar-H), 6.72-6.68 (dd, 1H, ^{3}J12.72Hz, ^{4}J2.24Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^{3}J6.64Hz 2 × Ar-O-CH$_2$-), 1.84-1.79 (m, 4H, 2 x Ar-O-CH$_2$-C$\underline{H}_2$-), 1.47-1.27 (m, 30H, 15 x -CH$_2$-), 0.89-0.87 (m, 6H, 2 x -CH$_3$).

1-(2-Fluoro-4-*n*-decyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxy-
benzoyloxy-4-benzoate), **7.A.5**

Yield, 74%; m.p. 90.0°C; ν$_{max}$: 3071, 2922, 2853, 1744, 1736, 1724, 1603, 1256, 1159, 1058 cm^{-1}; δ$_H$: 8.29-8.27 (d, 4H, ^{3}J8.52Hz, Ar-H), 8.16-8.14 (d, 2H, ^{3}J8.76Hz, Ar-H), 8.08-8.03 (t, 1H, ^{3}J8.64Hz, Ar-H), 7.52-7.49 (t, 1H, ^{3}J8.32Hz, Ar-H), 7.40-7.36 (m, 4H, Ar-H), 7.20-7.17 (m, 3H, Ar-H), 7.0-6.98 (d, 2H, ^{3}J8.76Hz, Ar-H), 6.80-6.78 (dd, 1H, ^{3}J8.88Hz, ^{4}J2.0Hz, Ar-H), 6.72-6.68 (dd, 1H, ^{3}J12.72Hz, ^{4}J2.04Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^{3}J6.68Hz, 2 × Ar-O-CH$_2$-), 1.84-1.79 (m, 4H, 2 × Ar-O-CH$_2$-C$\underline{H}_2$-), 1.47-1.27 (m, 32H, 16 × -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(2-Fluoro-4-*n*-undecyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxy-
benzoyloxy-4-benzoate), **7.A.6**

Yield, 75%; m.p. 96.0°C; ν$_{max}$: 3076, 2918, 2851, 1738, 1732, 1620, 1603, 1278, 1130, 1070 cm^{-1}; δ$_H$: 8.29-8.27 (d, 4H, ^{3}J8.56Hz, Ar-H), 8.16-8.14 (d, 2H, ^{3}J8.8Hz, Ar-H), 8.08-8.03 (t, 1H, ^{3}J8.64Hz, Ar-H), 7.52-7.49 (t, 1H, ^{3}J8.32Hz, Ar-H), 7.40-7.36 (m, 4H, Ar-H), 7.20-7.17 (m, 3H, Ar-H), 7.0-6.98 (d, 2H, ^{3}J8.8Hz, Ar-H), 6.80-6.78 (dd, 1H, ^{3}J8.88Hz, ^{4}J2.04Hz, Ar-H), 6.72-6.68 (dd, 1H, ^{3}J12.68Hz, ^{4}J2.04Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^{3}J6.68Hz, 2 x Ar-0-CHI-), 1.84-1.79 (m, 4H, 2 x Ar-O-CH$_2$-C$\underline{H}_2$-), 1.47-1.27 (m, 34H, 17 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(2-Fluoro-4-*n*-dodecyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxy-
benzoyloxy-4-benzoate), **7.A.7**

Yield, 68%; m.p. 98.0°C; ν$_{max}$: 3080, 2918, 2853, 1736, 1732, 1620, 1603, 1269, 1132, 1069 cm^{-1}; δ$_H$: 8.29-8.27 (d, 4H, ^{3}J8.44Hz, Ar-H), 8.16-8.14 (d, 2H, ^{3}J8.84Hz, Ar-H), 8.08-8.03 (t, 1H, ^{3}J8.64Hz, Ar-H), 7.52-7.49 (t, 1H, ^{3}J8.36Hz, Ar-H), 7.40-7.36 (m, 4H, Ar-H), 7.21-7.17 (m, 3H, Ar-H), 7.0-6.98 (d, 2H, ^{3}J8.84Hz, Ar-H), 6.80-6.78 (dd, 1H, ^{3}J8.84Hz, ^{4}J2.16Hz, Ar-H), 6.71-6.68 (dd, 1H, ^{3}J12.68Hz, ^{4}J2.2Hz, Ar-H), 4.07-4.02 (t x 2, 4H,

^{3}J6.68Hz, 2 × Ar-O-CH_2-), 1.84-1.79 (m, 4H, 2 x Ar-O-CH_2-$C\underline{H}_2$-), 1.47-1.27 (m, 36H, 18 x -CH_2-), 0.90-0.87 (m, 6H, 2 x -CH_3).

1-(2-Fluoro-4-*n*-tetradecyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxy-benzoyloxy-4-benzoate), 7.A.8

Yield, 70%; m.p. 80.0°C; ν; 3076, 2916, 2851, 1732, 1730, 1622, 1603, 1281, 1142, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 4H, ^{3}J8.32Hz, Ar-H), 8.16-8.14 (d, 2H, ^{3}J8.88Hz, Ar-H), 8.08-8.03 (t, 1H, ^{3}J8.64Hz, Ar-H), 7.52-7.49 (t, 1H, ^{3}J8.36Hz, Ar-H), 7.40-7.36 (m, 4H, Ar-H), 7.21-7.17 (m, 3H, Ar-H), 7.0-6.98 (d, 2H, ^{3}J8.88Hz, Ar-H), 6.80-6.78 (dd, 1H, ^{3}J8.92Hz, ^{4}J2.08Hz, Ar-H), 6.71-6.68 (dd, 1H, ^{3}J12.72Hz, ^{4}J2.24Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^{3}J6.6Hz, 2 x Ar-O-CH_2-), 1.84-1.79 (m, 4H, 2 x Ar-O-CH_2-$C\underline{H}_2$-), 1.47-1.27 (m, 40H, 20 x -CH_2-), 0.90-0.87 (m, 6H, 2 x -CH_3).

1-(2-Fluoro-4-*n*-hexadecyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxy-benzoyloxy-4-benzoate), 7.A.9

Yield, 64%; m.p. 79.0°C; ν_{max}: 3078, 2916, 2851, 1736, 1732, 1730, 1622, 1603, 1281, 1163, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 4H, ^{3}J8.4Hz, Ar-H), 8.16-8.14 (d, 2H, ^{3}J8.88Hz, Ar-H), 8.08-8.03 (t, 1H, ^{3}J8.64Hz, Ar-H), 7.52-7.49 (t, 1H, ^{3}J8.36Hz, Ar-H), 7.40-7.36 (m, 4H, Ar-H), 7.21-7.17 (m, 3H, Ar-H), 7.0-6.98 (d, 2H, ^{3}J8.88Hz, Ar-H), 6.80-6.78 (dd, 1H, ^{3}J8.8Hz, ^{4}J2.2Hz, Ar-H), 6.71-6.68 (dd, 1H, ^{3}J12.72Hz, ^{4}J2.28Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^{3}J6.56Hz, 2 x Ar-0-CHI-), 1.84-1.79 (m, 4H, 2 x Ar-O-CH_2-$C\underline{H}_2$-), 1.47-1.27 (m, 44H, 22 x -CH_2-), 0.90-0.86 (m, 6H, 2 x -CH_3).

1-(2-Fluoro-4-*n*-octadecyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxy-benzoyloxy-4-benzoate), 7.A.10

Yield, 72%; m.p. 79.0°C; ν_{max}: 3076, 2918, 2851, 1738, 1732, 1620, 1603, 1281, 1163, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 4H, ^{3}J8.44Hz, Ar-H), 8.16-8.14 (d, 2H, ^{3}J8.84Hz, Ar-H), 8.08-8.03 (t, 1H, ^{3}J8.64Hz, Ar-H), 7.52-7.49 (t, 1H, ^{3}J8.32Hz, Ar-H), 7.40-7.36 (m, 4H, Ar-H), 7.20-7.17 (m, 3H, Ar-H), 7.0-6.98 (d, 2H, ^{3}J8.84Hz, Ar-H), 6.80-6.78 (dd, 1H, ^{3}J8.88Hz, ^{4}J2.08Hz, Ar-H), 6.71-6.68 (dd, 1H, ^{3}J12.72Hz, ^{4}J2.24Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^{3}J6.6Hz, 2 x Ar-O-CH_2-), 1.84-1.79 (m, 4H, 2 x Ar-O-CH_2-$C\underline{H}_2$-), 1.48-1.26 (m, 48H, 24 x -CH_2-), 0.90-0.87 (m, 6H, 2 x -CH_3).

1-(3-Fluoro-4-*n*-hexyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxybenzoate), 7.B.1

Yield, 76%; m.p. 103.0°C; ν_{max}: 3073, 2922, 2853, 1734, 1605, 1256, 1163, 1061 cm^{-1}; δ_H: 8.30-8.27 (m, 4H, Ar-H), 8.16-8.14 (d, 2H, ^{3}J8.88Hz, Ar-H), 7.98-7.96 (d, 1H, ^{3}J8.64Hz, Ar-H), 7.93-7.89 (dd, 1H, ^{3}J11.44Hz, ^{4}J1.96Hz, Ar-H), 7.52-7.48 (t, 1H, ^{3}J8.32Hz, Ar-H), 7.38-7.36 (d, 4H, ^{3}J7.88Hz, Ar-H), 7.20-7.17 (m, 3H, Ar-H), 7.07-7.02 (t, 1H, ^{3}J8.32Hz, Ar-H), 7.00-6.98 (d, 2H, ^{3}J8.88Hz, Ar-H), 4.15-4.12 (t, 2H, ^{3}J6.6Hz, Ar-O-CH$_2$-), 4.07-4.02 (t, 2H, ^{3}J6.56Hz, Ar-0-CHI-), 1.91-1.79 (m, 4H, 2 x Ar-O-CH$_2$-C$\underline{H_2}$-), 1.54-1.27 (m, 24H, 12 x -CH$_2$-), 0.94-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-heptyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate), 7.B.2

Yield, 74%; m.p. 101.5°C; ν_{max}: 3073, 2924, 2853, 1747, 1736, 1726, 1603, 1256, 1163, 1061 cm^{-1}; δ_H: 8.30-8.27 (m, 4H, Ar-H), 8.16-8.14 (d, 2H, ^{3}J8.88Hz, Ar-H), 7.98-7.96 (d, 1H, ^{3}J8.64Hz, Ar-H), 7.93-7.89 (dd, 1H, ^{3}J11.44Hz, ^{4}J2.04Hz, Ar-H), 7.52-7.48 (t, 1H, ^{3}J8.36Hz, Ar-H), 7.38-7.36 (d, 4H, ^{3}J7.8Hz, Ar-H), 7.20-7.17 (m, 3H, Ar-H), 7.07-7.02 (t, 1H, ^{3}J8.28Hz, Ar-H), 7.00-6.98 (d, 2H, ^{3}J8.88Hz, Ar-H), 4.15-4.12 (t, 2H, ^{3}J6.6Hz, Ar-O-CH$_2$-), 4.07-4.02 (t, 2H, ^{3}J6.56Hz, Ar-0-CHI-), 1.91-1.79 (m, 4H, 2 x Ar-O-CH$_2$-C$\underline{H_2}$-), 1.52-1.27 (m, 26H, 13 × -CH$_2$-), 0.92-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-octyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate), 7.B.3

Yield, 70%; m.p. 102.0°C; ν_{max}: 3072, 2922, 2853, 1746, 1738, 1726, 1603, 1256, 1163, 1061 cm^{-1}; δ_H: 8.30-8.27 (m, 4H, Ar-H), 8.16-8.14 (d, 2H, ^{3}J8.76Hz, Ar-H), 7.98-7.96 (d, 1H, ^{3}J8.64Hz, Ar-H), 7.93-7.89 (dd, 1H, ^{3}J11.44Hz, ^{4}J1.92Hz, Ar-H), 7.52-7.48 (t, 1H, ^{3}J8.24Hz, Ar-H), 7.39-7.36 (d, 4H, ^{3}J8.56Hz, Ar-H), 7.20-7.17 (m, 3H, Ar-H), 7.07-7.02 (t, 1H, ^{3}J8.28Hz, Ar-H), 7.00-6.98 (d, 2H, ^{3}J8.76Hz, Ar-H), 4.15-4.12 (t, 2H, ^{3}J6.56Hz, Ar-O-CH$_2$-), 4.07-4.02 (t, 2H, ^{3}J6.52Hz, Ar-0-CHI-), 1.91-1.79 (m, 4H, 2 x Ar-O-CH$_2$-C$\underline{H_2}$-), 1.50-1.27 (m, 28H, 14 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-nonyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxy-benzoyloxy-4-benzoate), 7.B.4

Yield, 72%; m.p. 103.0°C; ν_{max}: 3078,2920,2853, 1736, 1605, 1281, 1163, 1061 cm^{-1}; δ_H: 8.30-8.27 (m, 4H, Ar-H), 8.16-8.14 (d, 2H, ^3J8.88Hz, Ar-H), 7.98-7.96 (d, 1H, ^3J8.64Hz, Ar-H), 7.93-7.89 (dd, 1H, ^3J11.48Hz, ^4J2.04Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.24Hz, Ar-H), 7.39-7.36 (d, 4H, ^3J8.6Hz, Ar-H), 7.20-7.17 (m, 3H, Ar-H), 7.07-7.02 (t, 1H, ^3J8.32Hz, Ar-H), 7.00-6.98 (d, 2H, ^3J8.88Hz, Ar-H), 4.15-4.12 (t, 2H, ^3J6.6Hz, Ar-O-CH$_2$-), 4.07-4.02 (t, 2H, ^3J6.52Hz, Ar-O-CH$_2$-), 1.91-1.79 (m, 4H, 2 x Ar-O-CH$_2$-C$\underline{H_2}$-), 1.50-1.27 (m, 30H, 15 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-decyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxy-benzoyloxy-4-benzoate), 7.B.5

Yield, 68%; m.p. 105.5°C; ν_{max}: 3080, 2920, 2853, 1736, 1730, 1605, 1281, 1163, 1061 cm^{-1}; δ_H: 8.30-8.27 (m, 4H, Ar-H), 8.16-8.14 (d, 2H, ^3J8.84Hz, Ar-H), 7.98-7.96 (d, 1H, ^3J8.72Hz, Ar-H), 7.93-7.89 (dd, 1H, ^3J11.44Hz, ^4J1.92Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.28Hz, Ar-H), 7.39-7.36 (d, 4H, ^3J7.8Hz, Ar-H), 7.20-7.17 (m, 3H, Ar-H), 7.07-7.02 (t, 1H, ^3J8.28Hz, Ar-H), 7.00-6.98 (d, 2H, ^3J8.84Hz, Ar-H), 4.15-4.12 (t, 2H, ^3J6.56Hz, Ar-O-CH$_2$-), 4.07-4.02 (t, 2H, ^3J6.52Hz, Ar-O-CH$_2$-), 1.91-1.79 (m, 4H, 2 x Ar-O-CH$_2$-C$\underline{H_2}$-), 1.53-1.27 (m, 32H, 16 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-undecyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxy-benzoyloxy-4-benzoate), 7.B.6

Yield, 71%; m.p. 108.0°C; ν_{max}: 3080, 2920, 2853, 1736, 1730, 1605, 1281, 1160, 1074 cm^{-1}; δ_H: 8.30-8.27 (m, 4H, Ar-H), 8.16-8.14 (d, 2H, ^3J8.88Hz, Ar-H), 7.98-7.96 (d, 1H, ^3J8.64Hz, Ar-H), 7.93-7.89 (dd, 1H, ^3J11.4Hz, ^4J2.0Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.4Hz, Ar-H), 7.39-7.36 (d, 4H, ^3J8.68Hz, Ar-H), 7.20-7.17 (m, 3H, Ar-H), 7.07-7.02 (t, 1H, ^3J8.28Hz, Ar-H), 7.00-6.98 (d, 2H, ^3J8.88Hz, Ar-H), 4.15-4.12 (t, 2H, ^3J6.56Hz, Ar-O-CH$_2$-), 4.07-4.02 (t, 2H, ^3J6.52Hz, Ar-O-CH$_2$-), 1.91-1.79 (m, 4H, 2 x Ar-O-CH$_2$-C$\underline{H_2}$-), 1.51-1.27 (m, 34H, 17 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-dodecyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxy-benzoyloxy-4-benzoate), 7.B.7

Yield, 68%; m.p. 110.0°C; ν_{max}: 3082,2916,2851,1736,1605, 1281,1160,1074 cm^{-1}; δ_H: 8.30-8.27 (m, 4H, Ar-H), 8.16-8.14 (d, 2H, ^3J8.84Hz, Ar-H), 7.98-7.96 (d, 1H, ^3J8.76Hz, Ar-H), 7.93-7.89 (dd, 1H, ^3J11.44Hz, ^4J1.92Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.28Hz, Ar-H), 7.39-7.36 (d, 4H, ^3J8.48Hz, Ar-H), 7.20-7.17 (m, 3H, Ar-H), 7.07-7.02 (t, 1H, ^3J8.44Hz, Ar-H), 7.00-6.98 (d, 2H, ^3J8.84Hz, Ar-H), 4.15-4.12 (t, 2H, ^3J6.56Hz, Ar-O-CH$_2$-), 4.07-4.02 (t, 2H, ^3J6.52Hz, Ar-O-CH$_2$-), 1.91-1.79 (m, 4H, 2 x Ar-O-CH$_2$-C$\underline{H}_2$-), 1.50-1.27 (m, 36H, 18 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-tetradecyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxy-benzoyloxy-4-benzoate), 7.B.8

Yield, 71%; m.p. 106.0°C; ν_{max}: 3072,2918,2851, 1736, 1605, 1281, 1160, 1074 cm^{-1}; δ_H: 8.30-8.27 (m, 4H, Ar-H), 8.16-8.14 (d, 2H, ^3J8.84Hz, Ar-H), 7.98-7.96 (d, 1H, ^3J8.88Hz, Ar-H), 7.93-7.89 (dd, 1H, ^3J11.4Hz, ^4J1.96Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.28Hz, Ar-H), 7.39-7.36 (d, 4H, ^3J7.64Hz, Ar-H), 7.20-7.17 (m, 3H, Ar-H), 7.07-7.02 (t, 1H, ^3J8.28Hz, Ar-H), 7.00-6.98 (d, 2H, ^3J8.84Hz, Ar-H), 4.15-4.12 (t, 2H, ^3J6.56Hz, Ar-O-CH$_2$-), 4.07-4.02 (t, 2H, ^3J6.52Hz, Ar-O-CH$_2$-), 1.91-1.79 (m, 4H, 2 x Ar-O-CH$_2$-C$\underline{H}_2$-), 1.53-1.27 (m, 40H, 20 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-hexadecyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxy-benzoyloxy-4-benzoate), 7.B.9

Yield, 73%; m.p. 100.0°C; ν_{max}: 3082,2918,2851,1736,1605,1281,1160,1074 cm^{-1}; δ_H: 8.30-8.27 (m, 4H, Ar-H), 8.16-8.14 (d, 2H, ^3J8.88Hz, Ar-H), 7.98-7.96 (d, 1H, ^3J8.84Hz, Ar-H), 7.93-7.89 (dd, 1H, ^3J11.4Hz, ^4J1.96Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.36Hz, Ar-H), 7.39-7.36 (d, 4H, ^3J8.6Hz, Ar-H), 7.20-7.17 (m, 3H, Ar-H), 7.07-7.02 (t, 1H, ^3J8.32Hz, Ar-H), 7.00-6.98 (d, 2H, ^3J8.88Hz, Ar-H), 4.15-4.12 (t, 2H, ^3J6.56Hz, Ar-O-CH$_2$-), 4.07-4.02 (t, 2H, ^3J6.52Hz, Ar-O-CH$_2$-), 1.91-1.79 (m, 4H, 2 × Ar-O-CH$_2$-C$\underline{H}_2$-), 1.50-1.26 (m, 44H, 22 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-octadecyloxybenzoyloxy-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate), 7.B.10

Yield, 74%; m.p. 99.0°C; ν; 3082,2916,2851,1736,1605,1281,1160,1068 cm^{-1}; δ_H: 8.30-8.27 (m, 4H, Ar-H), 8.16-8.14 (d, 2H, ^3J8.88Hz, Ar-H), 7.98-7.96 (d, 1H, ^3J8.64Hz, Ar-H), 7.93-7.89 (dd, 1H, ^3J11.36Hz, ^4J2.04Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.4Hz, Ar-H), 7.39-7.36 (d, 4H, ^3J8.68Hz, Ar-H), 7.20-7.17 (m, 3H, Ar-H), 7.07-7.02 (t, 1H, ^3J8.32Hz, Ar-H), 7.00-6.98 (d, 2H, ^3J8.88Hz, Ar-H), 4.15-4.12 (t, 2H, ^3J6.6Hz, Ar-O-CH_2-), 4.07-4.02 (t, 2H, ^3J6.56Hz, Ar-O-CH_2-), 1.91-1.79 (m, 4H, 2 x Ar-O-CH_2-$C\underline{H}_2$-), 1.50-1.26 (m, 48H, 24 x -CH_2-), 0.89-0.86 (m, 6H, 2 x -CH_3).

1-(2-Fluoro-4-*n*-hexyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate), 7.C.1

Yield, 77%; m.p. 97.5°C; ν_{max}: 3072, 2922, 2853, 1740, 1736, 1616, 1603, 1254, 1126, 1057 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.72Hz, Ar-H), 8.20-8.14 (m, 3H, Ar-H), 8.06-8.01 (t, 1H, ^3J8.64Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.24Hz, Ar-H), 7.39-7.36 (d, 2H, ^3J8.72Hz, Ar-H), 7.21-7.17 (m, 5H, Ar-H), 7.0-6.98 (d, 2H, ^3J8.92Hz, Ar-H), 6.80-6.78 (dd, 1H, ^3J8.84Hz, ^4J2.24Hz, Ar-H), 6.72-6.68 (dd, 1H, ^3J12.72Hz, ^4J2.24Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^3J6.68Hz, 2 × Ar-O-CH_2-), 1.84-1.79 (m, 4H, 2 x Ar-O-CH_2-$C\underline{H}_2$-), 1.48-1.27 (m, 24H, 12 x -CH_2-), 0.94-0.87 (m, 6H, 2 x -CH_3).

1-(2-Fluoro-4-*n*-heptyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate), 7.C.2

Yield, 71%; m.p. 97.0°C; ν_{max}: 3072, 2922, 2853, 1736, 1616, 1603, 1254, 1128, 1057 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.76Hz, Ar-H), 8.20-8.14 (m, 3H, Ar-H), 8.06-8.01 (t, 1H, ^3J8.68Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.16Hz, Ar-H), 7.39-7.36 (d, 2H, ^3J8.76Hz, Ar-H), 7.21-7.17 (m, 5H, Ar-H), 7.0-6.98 (d, 2H, ^3J8.96Hz, Ar-H), 6.80-6.78 (dd, 1H, ^3J8.8Hz, ^4J2.24Hz, Ar-H), 6.72-6.68 (dd, 1H, ^3J12.76Hz, ^4J2.32Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^3J6.68Hz, 2 x Ar-O-CH_2-), 1.84-1.79 (m, 4H, 2 x Ar-O-CH_2-$C\underline{H}_2$-), 1.48-1.27 (m, 26H, 13 x -CH_2-), 0.92-0.87 (m, 6H, 2 x -CH_3).

1-(2-Fluoro-4-*n*-octyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate), 7.C.3

Yield, 68%; m.p. 97.0°C; ν_{max}: 3072, 2922, 2853, 1736, 1616, 1603, 1254, 1128, 1057 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.72Hz, Ar-H), 8.20-8.14 (m, 3H, Ar-H), 8.06-8.01 (t, 1H, ^3J8.68Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.16Hz, Ar-H), 7.39-7.36 (d, 2H, ^3J8.72Hz, Ar-H), 7.21-7.17 (m, 5H, Ar-H), 7.0-6.98 (d, 2H, ^3J8.92Hz, Ar-H), 6.80-6.78 (dd, 1H, ^3J8.84Hz, ^4J2.2Hz, Ar-H), 6.72-6.68 (dd, 1H, ^3J12.72Hz, ^4J2.28Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^3J6.64Hz, 2 x Ar-O-CH_2-), 1.84-1.79 (m, 4H, 2 × Ar-O-CH_2-$C\underline{H}_2$-), 1.48-1.27 (m, 28H, 14 x -CH_2-), 0.90-0.87 (m, 6H, 2 x -CH_3).

1-(2-Fluoro-4-*n*-nonyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxybenzoate), 7.C.4

Yield, 69%; m.p. 98.0°C; ν_{max}: 3072, 2922, 2851, 1744, 1734, 1616, 1603, 1252, 1132, 1057 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.72Hz, Ar-H), 8.20-8.14 (m, 3H, Ar-H), 8.06-8.01 (t, 1H, ^3J8.68Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.16Hz, Ar-H), 7.39-7.36 (d, 2H, ^3J8.76Hz, Ar-H), 7.21-7.17 (m, 5H, Ar-H), 7.0-6.98 (d, 2H, ^3J8.92Hz, Ar-H), 6.80-6.78 (dd, 1H, ^3J8.84Hz, ^4J2.2Hz, Ar-H), 6.72-6.68 (dd, 1H, ^3J12.72Hz, ^4J2.28Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^3J6.64Hz, 2 × Ar-O-CH_2-), 1.84-1.79 (m, 4H, 2 x Ar-O-CH_2-$C\underline{H}_2$-), 1.48-1.27 (m, 30H, 15 x -CH_2-), 0.90-0.87 (m, 6H, 2 x -CH_3).

1-(2-Fluoro-4-*n*-decyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxybenzoate), 7.C.5

Yield, 71%; m.p. 87.0°C; ν_{max}: 3071, 2922, 2851, 1744, 1734, 1616, 1603, 1252, 1128, 1059 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.76Hz, Ar-H), 8.20-8.14 (m, 3H, Ar-H), 8.06-8.01 (t, 1H, ^3J8.68Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.16Hz, Ar-H), 7.39-7.36 (d, 2H, ^3J8.76Hz, Ar-H), 7.21-7.17 (m, 5H, Ar-H), 7.0-6.98 (d, 2H, ^3J8.92Hz, Ar-H), 6.80-6.78 (dd, 1H, ^3J8.92Hz, ^4J2.28Hz, Ar-H), 6.72-6.68 (dd, 1H, ^3J12.76Hz, ^4J2.32Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^3J6.6Hz, 2 × Ar-O-CH_2-), 1.84-1.79 (m, 4H, 2 x Ar-O-CH_2-$C\underline{H}_2$-), 1.48-1.27 (m, 32H, 16 x -CH_2-), 0.90-0.87 (m, 6H, 2 x -CH_3).

1-(2-Fluoro-4-*n*-undecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate), 7.C.6

Yield, 65%; m.p. 90.0°C; ν_{max}: 3072, 2922, 2853, 1744, 1736, 1616, 1603, 1254, 1128, 1059 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.76Hz, Ar-H), 8.20-8.14 (m, 3H, Ar-H), 8.06-8.01 (t, 1H, ^3J8.64Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.16Hz, Ar-H), 7.39-7.36 (d, 2H, ^3J8.76Hz, Ar-H), 7.21-7.18 (m, 5H, Ar-H), 7.0-6.98 (d, 2H, ^3J8.92Hz, Ar-H), 6.80-6.78 (dd, 1H, ^3J8.88Hz, ^4J2.24Hz, Ar-H), 6.72-6.68 (dd, 1H, ^3J12.76Hz, ^4J2.32Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^3J6.6Hz, 2 × Ar-O-CH_2-), 1.84-1.79 (m, 4H, 2 × Ar-O-CH_2-$C\underline{H}_2$-), 1.48-1.27 (m, 34H, 17 x -CH_2-), 0.90-0.87 (m, 6H, 2 x -CH_3).

1-(2-Fluoro-4-*n*-dodecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate), 7.C.7

Yield, 70%; m.p. 91.0°C; ν_{max}: 3078, 2924, 2851, 1749, 1742, 1618, 1603, 1254, 1128, 1059 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.72Hz, Ar-H), 8.20-8.14 (m, 3H, Ar-H), 8.06-8.01 (t, 1H, ^3J8.64Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.12Hz, Ar-H), 7.39-7.36 (d, 2H, ^3J8.72Hz, Ar-H), 7.22-7.18 (m, 5H, Ar-H), 7.0-6.98 (d, 2H, ^3J8.88Hz, Ar-H), 6.80-6.78 (dd, 1H, ^3J8.88Hz, ^4J2.24Hz, Ar-H), 6.72-6.68 (dd, 1H, ^3J12.72Hz, ^4J2.28Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^3J6.64Hz, 2 × Ar-O-CH_2-), 1.84-1.79 (m, 4H, 2 x Ar-O-CH_2-$C\underline{H}_2$-), 1.48-1.27 (m, 36H, 18 x -CH_2-), 0.90-0.87 (m, 6H, 2 x -CH_3).

1-(2-Fluoro-4-*n*-tetradecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate),7.C.8

Yield, 72%; m.p. 86.0°C; ν_{max}: 3071, 2922, 2851, 1757, 1732, 1614, 1603, 1256, 1124, 1051 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.68Hz, Ar-H), 8.20-8.14 (m, 3H, Ar-H), 8.06-8.01 (t, 1H, ^3J8.6Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.16Hz, Ar-H), 7.39-7.36 (d, 2H, ^3J8.68Hz, Ar-H), 7.22-7.18 (m, 5H, Ar-H), 7.0-6.98 (d, 2H, ^3J8.84Hz, Ar-H), 6.80-6.78 (dd, 1H, ^3J8.88Hz, ^4J2.16Hz, Ar-H), 6.72-6.68 (dd, 1H, ^3J12.76Hz, ^4J2.12Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^3J6.64Hz, 2 × Ar-O-CH_2-), 1.84-1.79 (m, 4H, 2 × Ar-O-CH_2-$C\underline{H}_2$-), 1.48-1.27 (m, 40H, 20 × -CH_2-), 0.90-0.87 (m, 6H, 2 x -CH_3).

1-(2-Fluoro-4-*n*-hexadecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate),7.C.9

Yield, 71%; m.p. 86.0°C; ν_{max}: 3076, 2920, 2851, 1744, 1736, 1618, 1605, 1252, 1128, 1051 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.72Hz, Ar-H), 8.20-8.14 (m, 3H, Ar-H), 8.06-8.01 (t, 1H, ^3J8.64Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.16Hz, Ar-H), 7.39-7.36 (d, 2H, ^3J8.72Hz, Ar-H), 7.22-7.18 (m, 5H, Ar-H), 7.0-6.98 (d, 2H, ^3J8.92Hz, Ar-H), 6.80-6.78 (dd, 1H, ^3J8.88Hz, ^4J2.16Hz, Ar-H), 6.72-6.68 (dd, 1H, ^3J12.72Hz, ^4J2.28Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^3J6.64Hz, 2 x Ar-O-CH$_2$-), 1.84-1.79 (m, 4H, 2 x Ar-O-CH$_2$-C$\underline{H}_2$-), 1.48-1.27 (m, 44H, 22 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(2-Fluoro-4-*n*-octadecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate),7.C.10

Yield, 69%; m.p. 93.0°C; ν_{max}: 3080, 2920, 2851, 1751, 1740, 1616, 1603, 1248, 1128, 1051 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.72Hz, Ar-H), 8.20-8.14 (m, 3H, Ar-H), 8.06-8.01 (t, 1H, ^3J8.64Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.2Hz, Ar-H), 7.39-7.36 (d, 2H, ^3J8.72Hz, Ar-H), 7.22-7.18 (m, 5H, Ar-H), 7.0-6.98 (d, 2H, ^3J8.92Hz, Ar-H), 6.80-6.78 (dd, 1H, ^3J8.84Hz, ^4J2.08Hz, Ar-H), 6.72-6.68 (dd, 1H, ^3J12.76Hz, ^4J2.2Hz, Ar-H), 4.07-4.02 (t x 2, 4H, ^3J6.6Hz, 2 × Ar-O-CH$_2$-), 1.84-1.79 (m, 4H, 2 x Ar-O-CH$_2$-C$\underline{H}_2$-), 1.48-1.27 (m, 48H, 24 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-hexyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate), 7.D.1

Yield, 65%; m.p. 101.O°C; ν_{max}: 3076, 2920, 2851, 1746, 1730, 1614, 1603, 1252, 1128, 1051 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.68Hz, Ar-H), 8.21-8.14 (m, 3H, Ar-H), 7.97-7.95 (d, 1H, ^3J8.64Hz, Ar-H), 7.90-7.87 (dd, 1H, ^3J11.36Hz, ^4J2.0Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.2Hz, Ar-H), 7.39-7.36 (d, 2H, ^3J8.68Hz, Ar-H), 7.23-7.17 (m, 5H, Ar-H), 7.07-7.02 (t, 1H, ^3J8.28Hz, Ar-H), 7.00-6.98 (d, 2H, ^3J8.88Hz, Ar-H), 4.15-4.12 (t, 2H, ^3J6.56Hz, Ar-O-CH$_2$-), 4.07-4.02 (t, 2H, ^3J6.52Hz, Ar-O-CH$_2$-), 1.91-1.79 (m, 4H, 2 × Ar-O-CH$_2$-C$\underline{H}_2$-), 1.54-1.26 (m, 24H, 12 x -CH$_2$-), 0.94-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-heptyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate),7.D.2

Yield, 67%; m.p. 101.0°C; ν_{max}: 3072, 2922, 2853, 1751, 1738, 1612, 1603, 1252, 1126, 1059 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.76Hz, Ar-H), 8.21-8.14 (m, 3H, Ar-H), 7.97-7.95 (d, 1H, ^3J8.64Hz, Ar-H), 7.90-7.87 (dd, 1H, ^3J11.4Hz, ^4J2.04Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.24Hz, Ar-H), 7.39-7.36 (d, 2H, ^3J8.76Hz, Ar-H), 7.23-7.17 (m, 5H, Ar-H), 7.07-7.02 (t, 1H, ^3J8.24Hz, Ar-H), 7.00-6.98 (d, 2H, ^3J8.92Hz, Ar-H), 4.15-4.12 (t, 2H, ^3J6.56Hz, Ar-O-CH$_2$-), 4.07-4.02 (t, 2H, ^3J6.52Hz, Ar-O-CH$_2$-), 1.91-1.79 (m, 4H, 2 x Ar-O-CH$_2$-C$\underline{H}_2$-), 1.52-1.26 (m, 26H, 13 x -CH$_2$-), 0.92-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-octyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate),7.D.3

Yield, 70%; m.p. 100.5°C; ν_{max}: 3074, 2920, 2851, 1746, 1736, 1728, 1614, 1603, 1252, 1126, 1059 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.72Hz, Ar-H), 8.21-8.14 (m, 3H, Ar-H), 7.97-7.95 (d, 1H, ^3J8.6Hz, Ar-H), 7.90-7.87 (dd, 1H, ^3J11.36Hz, ^4J2.04Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.2Hz, Ar-H), 7.39-7.36 (d, 2H, ^3J8.72Hz, Ar-H), 7.23-7.17 (m, 5H, Ar-H), 7.07-7.02 (t, 1H, ^3J8.28Hz, Ar-H), 7.00-6.98 (d, 2H, ^3J8.88Hz, Ar-H), 4.15-4.12 (t, 2H, ^3J6.56Hz, Ar-O-CH$_2$-), 4.07-4.02 (t, 2H, ^3J6.52Hz, Ar-O-CH$_2$-), 1.91-1.79(m, 4H, 2 x Ar-O-CH$_2$-C$\underline{H}_2$-), 1.52-1.28 (m, 28 H, 14 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-nonyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate), 7.D.4

Yield, 72%; m.p. 101.0°C; ν_{max}: 3074, 2922, 2853, 1744, 1732, 1614, 1605, 1252, 1126, 1061 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.68Hz, Ar-H), 8.21-8.14 (m, 3H, Ar-H), 7.97-7.95 (d, 1H, ^3J8.8Hz, Ar-H), 7.90-7.87 (dd, 1H, ^3J11.36Hz, ^4J1.96Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.2Hz, Ar-H), 7.39-7.36 (d, 2H, ^3J8.68Hz, Ar-H), 7.23-7.17 (m, 5H, Ar-H), 7.07-7.02 (t, 1H, ^3J8.28Hz, Ar-H), 7.00-6.98 (d, 2H, ^3J8.88Hz, Ar-H), 4.15-4.12 (t, 2H, ^3J6.56Hz, Ar-O-CH$_2$-), 4.07-4.02 (t, 2H, ^3J6.56Hz, Ar-O-CH$_2$-), 1.91-1.79 (m, 4H, 2 x Ar-O-CH$_2$-C$\underline{H}_2$-), 1.52-1.28 (m, 30H, 15 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-decyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate),7.D.5

Yield, 68%; m.p. 100.0°C; ν_{max}: 3072, 2920, 2851, 1745, 1736, 1728, 1619, 1605, 1252, 1124, 1059 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.64Hz, Ar-H), 8.21-8.14 (m, 3H, Ar-H), 7.97-7.95 (d, 1H, ^3J8.64Hz, Ar-H), 7.90-7.87 (dd, 1H, ^3J11.36Hz, ^4J1.96Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.2Hz, Ar-H), 7.39-7.36 (d, 2H, ^3J8.64Hz, Ar-H), 7.22-7.17 (m, 5H, Ar-H), 7.07-7.02 (t, 1H, ^3J8.24Hz, Ar-H), 7.00-6.98 (d, 2H, ^3J8.8Hz, Ar-H), 4.15-4.12 (t, 2H, ^3J6.56Hz, Ar-O-CH_2-), 4.07-4.02 (t, 2H, ^3J6.52Hz, Ar-O-CH_2-), 1.91-1.79(m, 4H, 2 x Ar-O-CH_2-$C\underline{H}_2$-), 1.52-1.28 (m, 32H, 16 x -CH_2-), 0.90-0.87 (m, 6H, 2 x -CH_3).

1-(3-Fluoro-4-*n*-undecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate),7.D.6

Yield, 70%; m.p. 99.5°C; ν_{max}: 3074, 2922, 2853, 1728, 1614, 1605, 1256, 1124, 1066 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.72Hz, Ar-H), 8.21-8.14 (m, 3H, Ar-H), 7.97-7.95 (d, 1H, ^3J8.56Hz, Ar-H), 7.90-7.87 (dd, 1H, ^3J11.36Hz, ^4J2.0Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.16Hz, Ar-H), 7.39-7.36 (d, 2H, ^3J8.72Hz, Ar-H), 7.22-7.17 (m, 5H, Ar-H), 7.07-7.02 (t, 1H, ^3J8.32Hz, Ar-H), 7.00-6.98 (d, 2H, ^3J8.88Hz, Ar-H), 4.15-4.12 (t, 2H, ^3J6.56Hz, Ar-O-CH_2-), 4.07-4.02 (t, 2H, ^3J6.52Hz, Ar-O-CH_2-), 1.91-1.79 (m, 4H, 2 x Ar-O-CH_2-$C\underline{H}_2$-), 1.50-1.28 (m, 34H, 17 x -CH_2-), 0.90-0.87 (m, 6H, 2 x -CH_3).

1-(3-Fluoro-4-*n*-dodecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-dodecyloxybenzoyloxy-4-benzoate),7.D.7

Yield, 68%; m.p. 97.0°C; ν_{max}: 3074, 2916, 2851, 1736, 1728, 1611, 1605, 1256, 1124, 1066 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.68Hz, Ar-H), 8.21-8.14 (m, 3H, Ar-H), 7.97-7.95 (d, 1H, ^3J8.48Hz, Ar-H), 7.90-7.87 (dd, 1H, ^3J11.36Hz, ^4J1.92Hz, Ar-H), 7.51-7.47 (t, 1H, ^3J8.16Hz, Ar-H), 7.39-7.36 (d, 2H, ^3J8.68Hz, Ar-H), 7.22-7.17 (m, 5H, Ar-H), 7.07-7.02 (t, 1H, ^3J8.32Hz, Ar-H), 7.00-6.98 (d, 2H, ^3J8.88Hz, Ar-H), 4.15-4.12 (t, 2H, ^3J6.52Hz, Ar-O-CH_2-), 4.07-4.02 (t, 2H, ^3J6.48Hz, Ar-O-CH_2-), 1.91-1.79 (m, 4H, 2 × Ar-O-CH_2-$C\underline{H}_2$-), 1.50-1.28 (m, 36H, 18 x -~Hz-),0.90-0.87 (m, 6H, 2 x -CH_3).

1-(3-Fluoro-4-*n*-tetradecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate), 7.D.8

Yield, 71%; m.p. 95.0°C; ν_{max}: 3071, 2920, 2851, 1744, 1730, 1614, 1603, 1252, 1124, 1066 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^{3}J8.68Hz, Ar-H), 8.21-8.14 (m, 3H, Ar-H), 7.97-7.95 (d, 1H, ^{3}J8.6Hz, Ar-H), 7.90-7.87 (dd, 1H, ^{3}J11.36Hz, ^{4}J2.0Hz, Ar-H), 7.51-7.47 (t, 1H, ^{3}J8.2Hz, Ar-H), 7.39-7.36 (d, 2H, ^{3}J8.68Hz, Ar-H), 7.22-7.17 (m, 5H, Ar-H), 7.07-7.02 (t, 1H, ^{3}J8.36Hz, Ar-H), 7.00-6.98 (d, 2H, ^{3}J8.88Hz, Ar-H), 4.15-4.12 (t, 2H, ^{3}J6.56Hz, Ar-O-CH$_2$-), 4.07-4.02 (t, 2H, ^{3}J6.52Hz, Ar-O-CH$_2$-), 1.91-1.79 (m, 4H, 2 x Ar-O-CH$_2$-C$\underline{H}_2$-), 1.50-1.27 (m, 40H, 20 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-hexadecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate), 7.D.9

Yield, 70%; m.p. 94.0°C; ν_{max}: 3071, 2920, 2851, 1751, 1736, 1614, 1603, 1254, 1124, 1066 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^{3}J8.68Hz, Ar-H), 8.21-8.14 (m, 3H, Ar-H), 7.97-7.95 (d, 1H, ^{3}J8.48Hz, Ar-H), 7.90-7.87 (dd, 1H, ^{3}J11.36Hz, ^{4}J1.96Hz, Ar-H), 7.51-7.47 (t, 1H, ^{3}J8.16Hz, Ar-H), 7.39-7.36 (d, 2H, ^{3}J8.68Hz, Ar-H), 7.22-7.17 (m, 5H, Ar-H), 7.07-7.02 (t, 1H, ^{3}J8.28Hz, Ar-H), 7.00-6.98 (d, 2H, ^{3}J8.84Hz, Ar-H), 4.15-4.12 (t, 2H, ^{3}J6.56Hz, Ar-O-CH$_2$-), 4.07-4.02 (t, 2H, ^{3}J6.52Hz, Ar-O-CH$_2$-), 1.91-1.79 (m, 4H, 2 × Ar-O-CH$_2$-C$\underline{H}_2$-), 1.50-1.27 (m, 44H, 22 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-hexadecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyloxybenzoyloxy-4-benzoate), 7.D.10

Yield, 66%; m.p. 93.0°C; ν_{max}: 3084, 2916, 2851, 1740, 1732, 1603, 1256, 1124, 1072 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^{3}J8.72Hz, Ar-H), 8.21-8.14 (m, 3H, Ar-H), 7.97-7.95 (d, 1H, ^{3}J8.52Hz, Ar-H), 7.90-7.87 (dd, 1H, ^{3}J11.32Hz, ^{4}J2.0Hz, Ar-H), 7.51-7.47 (t, 1H, ^{3}J8.2Hz, Ar-H), 7.39-7.36 (d, 2H, ^{3}J8.72Hz, Ar-H), 7.23-7.17 (m, 5H, Ar-H), 7.07-7.02 (t, 1H, ^{3}J8.32Hz, Ar-H), 7.00-6.98 (d, 2H, ^{3}J8.88Hz, Ar-H), 4.15-4.12 (t, 2H, ^{3}J6.56Hz, Ar-O-CH$_2$-), 4.07-4.02 (t, 2H, ^{3}J6.52Hz, Ar-O-CH$_2$-), 1.91-1.79 (m, 4H, 2 × Ar-O-CH$_2$-C$\underline{H}_2$-), 1.50-1.27 (m, 48H, 24 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(2-Fluoro-4-*n*-hexyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyl-benzoyloxy-4-benzoate), **7.E.1**

Yield, 74%; m.p. 90.0°C; ν_{max}: 3074, 2922, 2853, 1742, 1730, 1728, 1612, 1271, 1136, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^{3}J8.76Hz, Ar-H), 8.20-8.16 (t, 1H, ^{3}J8.48Hz, Ar-H), 8.13-8.11 (d, 2H, ^{3}J8.24Hz, Ar-H), 8.05-8.01 (t, 1H, ^{3}J8.68Hz, Ar-H), 7.51-7.47 (t, 1H, ^{3}J8.16Hz, Ar-H), 7.39-7.37 (d, 2H, ^{3}J8.76Hz, Ar-H), 7.34-7.32 (d, 2H, ^{3}J8.24Hz, Ar-H), 7.22-7.18 (m, 5H, Ar-H), 6.81-6.78 (dd, 1H, ^{3}J8.92Hz, ^{4}J2.2Hz, Ar-H), 6.72-6.68 (dd, 1H, ^{3}J12.72Hz, ^{4}J2.28Hz, Ar-H), 4.06-4.02 (t, 2H, ^{3}J6.52Hz, Ar-O-CH$_2$-), 2.73-2.69 (t, 2H, ^{3}J7.6Hz, Ar-CH$_2$-), 1.86-1.79 (quin, 2H, ^{3}J7.04Hz, Ar-O-CH$_2$-C$\underline{H}_2$-), 1.69-1.63 (quin, 2H, ^{3}J7.04Hz, Ar-CH$_2$-C$\underline{H}_2$-), 1.50-1.27 (m, 24H, 12 x -CH$_2$-), 0.94-0.87 (m, 6H, 2 x -CH$_3$).

1-(2-Fluoro-4-*n*-heptyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyl-benzoyloxy-4-benzoate), **7.E.2**

Yield, 70%; m.p. 88.0°C; ν_{max}: 3071, 2922, 2855, 1738, 1736, 1616, 1263, 1136, 1060 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^{3}J8.76Hz, Ar-H), 8.20-8.16 (t, 1H, ^{3}J8.52Hz, Ar-H), 8.13-8.11 (d, 2H, ^{3}J8.24Hz, Ar-H), 8.05-8.01 (t, 1H, ^{3}J8.64Hz, Ar-H), 7.51-7.47 (t, 1H, ^{3}J8.12Hz, Ar-H), 7.39-7.37 (d, 2H, ^{3}J8.76Hz, Ar-H), 7.34-7.32 (d, 2H, ^{3}J8.24Hz, Ar-H), 7.22-7.18 (m, 5H, Ar-H), 6.81-6.78 (dd, 1H, ^{3}J8.88Hz, ^{4}J2.24Hz, Ar-H), 6.72-6.68 (dd, 1H, ^{3}J12.76Hz, ^{4}J2.28Hz, Ar-H), 4.06-4.02 (t, 2H, ^{3}J6.52Hz, Ar-O-CH$_2$-), 2.73-2.69 (t, 2H, ^{3}J7.52Hz, Ar-CH$_2$-), 1.86-1.79 (quin, 2H, ^{3}J6.92Hz, Ar-O-CH$_2$-C$\underline{H}_2$-), 1.69-1.63 (quin, 2H, ^{3}J7.16Hz, Ar-CH$_2$-C$\underline{H}_2$-), 1.50-1.27 (m, 26H, 13 x -CH$_2$-), 0.92-0.87 (m, 6H, 2 x -CH$_3$).

1-(2-Fluoro-4-*n*-octyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecyl-benzoyloxy-4-benzoate), **7.E.3**

Yield, 68%; m.p. 77.0°C; ν_{max}: 3074, 2922, 2853, 1730, 1728, 1614, 1271, 1136, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^{3}J8.68Hz, Ar-H), 8.20-8.16 (t, 1H, ^{3}J8.48Hz, Ar-H), 8.13-8.11 (d, 2H, ^{3}J8.16Hz, Ar-H), 8.05-8.01 (t, 1H, ^{3}J8.64Hz, Ar-H), 7.51-7.47 (t, 1H, ^{3}J8.16Hz, Ar-H), 7.39-7.37 (d, 2H, ^{3}J8.68Hz, Ar-H), 7.34-7.32 (d, 2H, ^{3}J8.16Hz, Ar-H), 7.21-7.18 (m, 5H, Ar-H), 6.81-6.78 (dd, 1H, ^{3}J8.92Hz, ^{4}J2.04Hz, Ar-H), 6.72-6.68 (dd, 1H, ^{3}J12.72Hz, ^{4}J2.12Hz, Ar-H), 4.06-4.02 (t, 2H, ^{3}J6.48Hz, Ar-O-CH$_2$-), 2.73-2.69 (t, 2H, ^{3}J7.56Hz, Ar-CH$_2$-), 1.86-1.79 (quin, 2H, ^{3}J7.0Hz, Ar-O-CH$_2$-C$\underline{H}_2$-), 1.69-1.63 (quin, 2H, ^{3}J7.0Hz, Ar-CH$_2$-C$\underline{H}_2$-), 1.50-1.27 (m, 28H, 14 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(2-Fluoro-4-*n*-nonyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecylbenzoyloxy-4-benzoate), 7.E.4

Yield, 72%; m.p. 84.0°C; ν_{max}: 3067, 2922, 2853, 1738, 1736, 1618, 1250, 1138, 1067 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^{3}J8.72Hz, Ar-H), 8.20-8.16 (t, 1H, ^{3}J8.52Hz, Ar-H), 8.13-8.11 (d, 2H, ^{3}J8.2Hz, Ar-H), 8.05-8.01 (t, 1H, ^{3}J8.56Hz, Ar-H), 7.51-7.47 (t, 1H, ^{3}J8.16Hz, Ar-H), 7.39-7.37 (d, 2H, ^{3}J8.72Hz, Ar-H), 7.34-7.32 (d, 2H, ^{3}J8.2Hz, Ar-H), 7.22-7.18 (m, 5H, Ar-H), 6.81-6.78 (dd, 1H, ^{3}J8.88Hz, ^{4}J2.0Hz, Ar-H), 6.72-6.68 (dd, 1H, ^{3}J12.76Hz, ^{4}J2.28Hz, Ar-H), 4.06-4.02 (t, 2H, ^{3}J6.52Hz, Ar-O-CH$_2$-), 2.73-2.69 (t, 2H, ^{3}J7.48Hz, Ar-CH$_2$-), 1.86-1.79 (quin, 2H, ^{3}J6.88Hz, Ar-O-CH$_2$-C$\underline{H}_2$-), 1.69-1.63 (quin, 2H, ^{3}J6.92Hz, Ar-CH$_2$-C$\underline{H}_2$-), 1.51-1.27 (m, 30H, 15 x -CH$_2$-), 0.89-0.87 (m, 6H, 2 x -CH$_3$).

1-(2-Fluoro-4-*n*-decyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecylbenzoyloxy-4-benzoate), 7.E.5

Yield, 70%; m.p. 89.5°C; ν_{max}: 3069, 2922, 2853, 1736, 1732, 1614, 1250, 1138, 1067 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^{3}J8.76Hz, Ar-H), 8.20-8.16 (t, 1H, ^{3}J8.6Hz, Ar-H), 8.13-8.11 (d, 2H, ^{3}J8.2Hz, Ar-H), 8.05-8.01 (t, 1H, ^{3}J8.64Hz, Ar-H), 7.51-7.47 (t, 1H, ^{3}J8.2Hz, Ar-H), 7.39-7.37 (d, 2H, ^{3}J8.76Hz, Ar-H), 7.34-7.32 (d, 2H, ^{3}J8.2Hz, Ar-H), 7.23-7.18 (m, 5H, Ar-H), 6.81-6.78 (dd, 1H, ^{3}J8.88Hz, ^{4}J2.16Hz, Ar-H), 6.72-6.68 (dd, 1H, ^{3}J12.76Hz, ^{4}J2.24Hz, Ar-H), 4.06-4.02 (t, 2H, ^{3}J6.52Hz, Ar-O-CH$_2$-), 2.73-2.69 (t, 2H, ^{3}J7.52Hz, Ar-CH$_2$-), 1.86-1.79 (quin, 2H, ^{3}J6.96Hz, Ar-O-CH$_2$-C$\underline{H}_2$-), 1.69-1.63 (quin, 2H, ^{3}J7.2Hz, Ar-CH$_2$-C$\underline{H}_2$-), 1.51-1.27 (m, 32H, 16 × -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(2-Fluoro-4-*n*-undecyloxybenzoyloxy-2-fluoro-4-benzoylo)phenylene-3-dodecylbenzoyloxy-4-benzoate), 7.E.6

Yield, 68%; m.p. 73.5°C; ν_{max}: 3076, 2920, 2853, 1742, 1732, 1730, 1614, 1250, 1136, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^{3}J8.68Hz, Ar-H), 8.20-8.16 (t, 1H, ^{3}J8.52Hz, Ar-H), 8.13-8.11 (d, 2H, ^{3}J8.16Hz, Ar-H), 8.05-8.01 (t, 1H, ^{3}J8.6Hz, Ar-H), 7.51-7.47 (t, 1H, ^{3}J8.16Hz, Ar-H), 7.39-7.37 (d, 2H, ^{3}J8.68Hz, Ar-H), 7.34-7.32 (d, 2H, ^{3}J8.16Hz, Ar-H), 7.23-7.18 (m, 5H, Ar-H), 6.81-6.78 (dd, 1H, ^{3}J8.92Hz, ^{4}J2.16Hz, Ar-H), 6.72-6.68 (dd, 1H, ^{3}J12.76Hz, ^{4}J2.24Hz, Ar-H), 4.06-4.02 (t, 2H, ^{3}J6.52Hz, Ar-O-CH$_2$-), 2.73-2.69 (t, 2H, ^{3}J7.48Hz, Ar-CH$_2$-), 1.86-1.79 (quin, 2H, ^{3}J6.92Hz, Ar-O-CH$_2$-C$\underline{H}_2$-), 1.69-1.63 (quin, 2H, ^{3}J7.16Hz, Ar-CH$_2$-C$\underline{H}_2$-), 1.48-1.26 (m, 34H, 17 x -CH$_2$-), 0.9-0.87 (m, 6H, 2 x -CH$_3$).

1-(2-Fluoro-4-*n*-dodecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecylbenzoyloxy-4-benzoate),7.E.7

Yield, 73%; m.p. 72.0°C; ν_{max}: 3078, 2920, 2853, 1744, 1730, 1728, 1614, 1250, 1136, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^{3}J8.72Hz, Ar-H), 8.20-8.16 (t, 1H, ^{3}J8.48Hz, Ar-H), 8.13-8.11 (d, 2H, ^{3}J8.2Hz, Ar-H), 8.05-8.01 (t, 1H, ^{3}J8.64Hz, Ar-H), 7.51-7.47 (t, 1H, ^{3}J8.16Hz, Ar-H), 7.39-7.37 (d, 2H, ^{3}J8.72Hz, Ar-H), 7.34-7.32 (d, 2H, ^{3}J8.2Hz, Ar-H), 7.22-7.18 (m, 5H, Ar-H), 6.80-6.78 (dd, 1H, ^{3}J8.88Hz, ^{4}J2.24Hz, Ar-H), 6.72-6.68 (dd, 1H, ^{3}J12.76Hz, ^{4}J2.28Hz, Ar-H), 4.06-4.02 (t, 2H, ^{3}J6.52Hz, Ar-O-CH$_2$-), 2.73-2.69 (t, 2H, ^{3}J7.52Hz, Ar-CH$_2$-), 1.86-1.79 (quin, 2H, ^{3}J6.96Hz, Ar-O-CH$_2$-C$\underline{H}_2$-), 1.69-1.64 (quin, 2H, ^{3}J7.08Hz, Ar-CH$_2$-C$\underline{H}_2$-), 1.49-1.27 (m, 36H, 18 x CH$_2$-), 0.9-0.87 (m, 6H, 2 x -CH$_3$).

1-(2-Fluoro-4-*n*-tetradecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecylbenzoyloxy-4-benzoate),7.E.8

Yield, 75%; m.p. 73.5°C; ν_{max}: 3078, 2920, 2853, 1742, 1732, 1730, 1615, 1250, 1136, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^{3}J8.76Hz, Ar-H), 8.20-8.16 (t, 1H, ^{3}J8.64Hz, Ar-H), 8.13-8.11 (d, 2H, ^{3}J8.28Hz, Ar-H), 8.05-8.01 (t, 1H, ^{3}J8.68Hz, Ar-H), 7.51-7.47 (t, 1H, ^{3}J8.2Hz, Ar-H), 7.39-7.37 (d, 2H, ^{3}J8.76Hz, Ar-H), 7.34-7.32 (d, 2H, ^{3}J8.28Hz, Ar-H), 7.23-7.18 (m, 5H, Ar-H), 6.81-6.78 (dd, 1H, ^{3}J8.92Hz, ^{4}J2.16Hz, Ar-H), 6.72-6.68 (dd, 1H, ^{3}J12.72Hz, ^{4}J2.32Hz, Ar-H), 4.06-4.02 (t, 2H, ^{3}J6.52Hz, Ar-O-CH$_2$-), 2.73-2.69 (t, 2H, ^{3}J7.6Hz, Ar-CH$_2$-), 1.86-1.79 (quin, 2H, ^{3}J6.96Hz, Ar-O-CH$_2$-C$\underline{H}_2$-), 1.69-1.63 (quin, 2H, ^{3}J7.06Hz, Ar-CH$_2$-C$\underline{H}_2$-), 1.48-1.26 (m, 40H, 20 x -CH$_2$-), 0.9-0.87 (m, 6H, 2 x -CH$_3$).

1-(2-Fluoro-4-*n*-hexadecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecylbenzoyloxy-4-benzoate), 7.E.9

Yield, 69%; m.p. 69.0°C; ν_{max}: 3078, 2920, 2853, 1744, 1732, 1728, 1614, 1250, 1136, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^{3}J8.76Hz, Ar-H), 8.20-8.16 (t, 1H, ^{3}J8.6Hz, Ar-H), 8.13-8.11 (d, 2H, ^{3}J8.24Hz, Ar-H), 8.05-8.01 (t, 1H, ^{3}J8.68Hz, Ar-H), 7.51-7.47 (t, 1H, ^{3}J8.2Hz, Ar-H), 7.39-7.37 (d, 2H, ^{3}J8.76Hz, Ar-H), 7.34-7.32 (d, 2H, ^{3}J8.24Hz, Ar-H), 7.23-7.18 (m, 5H, Ar-H), 6.81-6.78 (dd, 1H, ^{3}J8.92Hz, ^{4}J2.2Hz, Ar-H), 6.72-6.68 (dd, 1H, ^{3}J12.76Hz, ^{4}J2.32Hz, Ar-H), 4.06-4.02 (t, 2H, ^{3}J6.52Hz, Ar-O-CH$_2$-), 2.73-2.69 (t, 2H, ^{3}J7.56Hz, Ar-CH$_2$-), 1.86-1.79 (quin, 2H, ^{3}J7.04Hz, Ar-O-CH$_2$-C$\underline{H}_2$-), 1.69-1.63 (quin, 2H, ^{3}J7.16Hz, Ar-CH$_2$-C$\underline{H}_2$-), 1.47-1.26 (m, 44H, 22 x -CH$_2$-), 0.9-0.87 (m, 6H, 2 x -CH$_3$).

1-(2-Fluoro-4-*n*-octadecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecylbenzoyloxy-4-benzoate), 7.E.10

Yield, 70%; m.p. 72.5°C; ν_{max}: 3078, 2920, 2851, 1742, 1732, 1728, 1614, 1250, 1136, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.76Hz, Ar-H), 8.20-8.16 (t, 1H, ^3J8.6Hz, Ar-H), 8.13-8.11 (d, 2H, ^3J8.2Hz, Ar-H), 8.05-8.01 (t, 1H, ^3J8.64Hz, Ar-H), 7.51-7.47 (t, 1H, ^3J8.2Hz, Ar-H), 7.39-7.37 (d, 2H, ^3J8.76Hz, Ar-H), 7.34-7.32 (d, 2H, ^3J8.2Hz, Ar-H), 7.23-7.18 (m, 5H, Ar-H), 6.81-6.78 (dd, 1H, ^3J8.88Hz, ^4J2.12Hz, Ar-H), 6.72-6.68 (dd, 1H, ^3J12.72Hz, ^4J2.24Hz, Ar-H), 4.06-4.02 (t, 2H, ^3J6.52Hz, Ar-O-CH_2-), 2.73-2.69 (t, 2H, ^3J7.52Hz, Ar-CH_2-), 1.86-1.79 (quin, 2H, ^3J6.96Hz, Ar-O-CH_2-$C\underline{H}_2$-), 1.69-1.63 (quin, 2H, ^3J7.12Hz, Ar-CH_2-$C\underline{H}_2$-), 1.47-1.26 (m, 48H, 24 x -CH_2-), 0.9-0.87 (m, 6H, 2 x -CH_3).

1-(3-Fluoro-4-*n*-hexyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecylbenzoyloxy-4-benzoate), 7.F.1

Yield, 68%; m.p. 103.0°C; ν_{max}: 3071, 2922, 2851, 1751, 1736, 1732, 1620, 1253, 1128, 1061 cm^{-1}; δ_H: 8.30-8.27 (d, 2H, ^3J8.68Hz, Ar-H), 8.21-8.17 (t, 1H, ^3J8.6Hz, Ar-H), 8.13-8.11 (d, 2H, ^3J8.2Hz, Ar-H), 7.97-7.95 (d, 1H, ^3J8.64Hz, Ar-H), 7.90-7.87 (dd, 1H, ^3J11.36Hz, ^4J2.0Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.2Hz, Ar-H), 7.39-7.37 (d, 2H, ^3J8.68Hz, Ar-H), 7.35-7.33 (d, 2H, ^3J8.2Hz, Ar-H), 7.23-7.17 (m, 5H, Ar-H), 7.07-7.05 (t, 1H, ^3J8.32Hz, Ar-H), 4.15-4.11 (t, 2H, ^3J6.6Hz, Ar-O-CH_2-), 2.73-2.69 (t, 2H, ^3J7.6Hz, Ar-CH_2-), 1.91-1.84 (quin, 2H, ^3J7.16Hz, Ar-O-CH_2-$C\underline{H}_2$-), 1.68-1.27 (m, 26H, 13 x -CH_2-), 0.94-0.87 (m, 6H, 2 x -CH_3).

1-(3-Fluoro-4-*n*-heptyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecylbenzoyloxy-4-benzoate), 7.F.2

Yield, 71%; m.p. 98.5°C; ν_{max}: 3071, 2924, 2855, 1751, 1738, 1726, 1612, 1288, 1136, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.68Hz, Ar-H), 8.21-8.17 (t, 1H, ^3J8.32Hz, Ar-H), 8.13-8.11 (d, 2H, ^3J8.16Hz, Ar-H), 7.97-7.95 (d, 1H, ^3J8.52Hz, Ar-H), 7.90-7.87 (dd, 1H, ^3J11.36Hz, ^4J1.96Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.16Hz, Ar-H), 7.39-7.37 (d, 2H, ^3J8.68Hz, Ar-H), 7.35-7.32 (d, 2H, ^3J8.12Hz, Ar-H), 7.23-7.17 (m, 5H, Ar-H), 7.07-7.05 (t, 1H, ^3J8.2Hz, Ar-H), 4.15-4.11 (t, 2H, ^3J6.56Hz, Ar-O-CH_2-), 2.73-2.69 (t, 2H, ^3J7.52Hz, Ar-CH_2-), 1.91-1.84 (quin, 2H, ^3J7.04Hz, Ar-O-CH_2-$C\underline{H}_2$-), 1.66-1.27 (m, 28H, 14 x -CH_2-), 0.92-0.87 (m, 6H, 2 x -CH_3).

1-(3-Fluoro-4-*n*-octyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecylbenzoyloxy-4-benzoate), 7.F.3

Yield, 72%; m.p. 97.5°C; ν_{max}: 3074, 2924, 2853, 1753, 1728, 1726, 1612, 1288, 1136, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.64Hz, Ar-H), 8.21-8.17 (t, 1H, ^3J8.4Hz, Ar-H), 8.13-8.11 (d, 2H, ^3J8.16Hz, Ar-H), 7.97-7.95 (d, 1H, ^3J8.56Hz, Ar-H), 7.90-7.87 (dd, 1H, ^3J11.4Hz, ^4J1.96Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.16Hz, Ar-H), 7.39-7.37 (d, 2H, ^3J8.68Hz, Ar-H), 7.35-7.32 (d, 2H, ^3J8.16Hz, Ar-H), 7.23-7.17 (m, 5H, Ar-H), 7.07-7.05 (t, 1H, ^3J8.24Hz, Ar-H), 4.15-4.11 (t, 2H, ^3J6.56Hz, Ar-O-CH$_2$-), 2.73-2.69 (t, 2H, ^3J7.44Hz, Ar-CH$_2$-), 1.91-1.84 (quin, 2H, ^3J6.96Hz, Ar-O-CH$_2$-C$\underline{H}_2$-), 1.66-1.27 (m, 30H, 15 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-nonyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecylbenzoyloxy-4-benzoate), 7.F.4

Yield, 74%; m.p. 96.0°C; ν_{max}: 3071, 2920, 2853, 1740, 1736, 1730, 1612, 1288, 1136, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.68Hz, Ar-H), 8.21-8.17 (t, 1H, ^3J8.36Hz, Ar-H), 8.13-8.11 (d, 2H, ^3J8.16Hz, Ar-H), 7.97-7.95 (d, 1H, ^3J8.56Hz, Ar-H), 7.90-7.87 (dd, 1H, ^3J11.36Hz, ^4J1.96Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.16Hz, Ar-H), 7.39-7.37 (d, 2H, ^3J8.68Hz, Ar-H), 7.35-7.32 (d, 2H, ^3J8.16Hz, Ar-H), 7.23-7.17 (m, 5H, Ar-H), 7.07-7.05 (t, 1H, ^3J8.24Hz, Ar-H), 4.15-4.11 (t, 2H, ^3J6.6Hz, Ar-O-CH$_2$-), 2.73-2.69 (t, 2H, ^3J7.48Hz, Ar-CH$_2$-), 1.91-1.84 (quin, 2H, ^3J7.04Hz, Ar-O-CH$_2$-C$\underline{H}_2$-), 1.66-1.27 (m, 32H, 16 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-decyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecylbenzoyloxy-4-benzoate), 7.F.5

Yield, 68%; m.p. 95.0°C; ν_{max}: 3071, 2920, 2851, 1740, 1736, 1730, 1610, 1289, 1136, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.72Hz, Ar-H), 8.21-8.17 (t, 1H, ^3J8.4Hz, Ar-H), 8.13-8.11 (d, 2H, ^3J8.2Hz, Ar-H), 7.97-7.95 (d, 1H, ^3J8.6Hz, Ar-H), 7.90-7.87 (dd, 1H, ^3J11.4Hz, ^4J2.0Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.2Hz, Ar-H), 7.39-7.37 (d, 2H, ^3J8.68Hz, Ar-H), 7.35-7.32 (d, 2H, ^3J8.16Hz, Ar-H), 7.23-7.17 (m, 5H, Ar-H), 7.07-7.05 (t, 1H, ^3J8.28Hz, Ar-H), 4.15-4.11 (t, 2H, ^3J6.56Hz, Ar-O-CH$_2$-), 2.73-2.69 (t, 2H, ^3J7.52Hz, Ar-CH$_2$-), 1.91-1.84 (quin, 2H, ^3J7.04Hz, Ar-O-CH$_2$-C$\underline{H}_2$-), 1.66-1.27 (m, 34H, 17 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 × -CH$_3$).

1-(3-Fluoro-4-*n*-undecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecylbenzoyloxy-4-benzoate),7.F.6

Yield, 75%; m.p. 94.0°C; ν_{max}: 3071, 2920, 2849, 1738, 1736, 1730, 1614, 1288, 1136, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.68Hz, Ar-H), 8.21-8.17 (t, 1H, ^3J8.6Hz, Ar-H), 8.13-8.11 (d, 2H, ^3J8.16Hz, Ar-H), 7.97-7.95 (d, 1H, ^3J8.68Hz, Ar-H), 7.90-7.87 (dd, 1H, ^3J11.36Hz, ^4J1.92Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.12Hz, Ar-H), 7.39-7.37 (d, 2H, ^3J8.64Hz, Ar-H), 7.35-7.32 (d, 2H, ^3J8.12Hz, Ar-H), 7.23-7.17 (m, 5H, Ar-H), 7.07-7.05 (t, 1H, ^3J8.28Hz, Ar-H), 4.15-4.11 (t, 2H, ^3J6.56Hz, Ar-O-CH$_2$-), 2.73-2.69 (t, 2H, ^3J7.52Hz, Ar-CH$_2$-), 1.91-1.84 (quin, 2H, ^3J7.12Hz, Ar-O-CH$_2$-C$\underline{H}_2$-), 1.66-1.26 (m, 36H, 18 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-dodecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-n-dodecylbenzoyloxy-4-benzoate),7.F.7

Yield, 70%; m.p. 94.0°C; ν_{max}: 3071, 2918, 2851, 1740, 1735, 1730, 1618, 1288, 1136, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.76Hz, Ar-H), 8.21-8.17 (t, 1H, ^3J8.52Hz, Ar-H), 8.13-8.11 (d, 2H, ^3J8.24Hz, Ar-H), 7.97-7.95 (d, 1H, ^3J8.72Hz, Ar-H), 7.90-7.87 (dd, 1H, ^3J11.36Hz, ^4J2.04Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.24Hz, Ar-H), 7.39-7.37 (d, 2H, ^3J8.76Hz, Ar-H), 7.35-7.32 (d, 2H, ^3J8.24Hz, Ar-H), 7.23-7.17 (m, 5H, Ar-H), 7.07-7.05 (t, 1H, ^3J8.28Hz, Ar-H), 4.15-4.11 (t, 2H, ^3J6.56Hz, Ar-O-CH$_2$-), 2.73-2.69 (t, 2H, ^3J7.6Hz, Ar-CH$_2$-), 1.91-1.84 (quin, 2H, ^3J7.04Hz, Ar-O-CH$_2$-C$\underline{H}_2$-), 1.66-1.27 (m, 38H, 19 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 x -CH$_3$).

1-(3-Fluoro-4-*n*-tetradecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecylbenzoyloxy-4-benzoate), **7.F.8**

Yield, 65%; m.p. 90.0°C; ν_{max}: 3071, 2918, 2851, 1740, 1730, 1616, 1285, 1136, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.72Hz, Ar-H), 8.21-8.17 (t, 1H, ^3J8.48Hz, Ar-H), 8.13-8.11 (d, 2H, ^3J8.24Hz, Ar-H), 7.97-7.95 (d, 1H, ^3J8.56Hz, Ar-H), 7.90-7.87 (dd, 1H, ^3J11.4Hz, ^4J2.04Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.2Hz, Ar-H), 7.39-7.37 (d, 2H, ^3J8.72Hz, Ar-H), 7.35-7.32 (d, 2H, ^3J8.2Hz, Ar-H), 7.23-7.17 (m, 5H, Ar-H), 7.07-7.05 (t, 1H, ^3J8.28Hz, Ar-H), 4.15-4.11 (t, 2H, ^3J6.56Hz, Ar-O-CH$_2$-), 2.73-2.69 (t, 2H, ^3J7.56Hz, Ar-CH$_2$-), 1.91-1.84 (quin, 2H, ^3J7.04Hz, Ar-O-CH$_2$-C$\underline{H}_2$-), 1.66-1.27 (m, 42H, 21 x -CH$_2$-), 0.90-0.87 (m, 6H, 2 × -CH$_3$).

1-(3-Fluoro-4-*n*-hexadecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecylbenzoyloxy-4-benzoate), 7.F.9

Yield, 68%; m.p. 87.0°C; ν_{max}: 3076, 2922, 2853, 1740, 1728, 1614, 1285, 1138, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.68Hz, Ar-H), 8.21-8.17 (t, 1H, ^3J8.44Hz, Ar-H), 8.13-8.11 (d, 2H, ^3J8.16Hz, Ar-H), 7.97-7.95 (d, 1H, ^3J8.6Hz, Ar-H), 7.90-7.87 (dd, 1H, ^3J11.36Hz, ^4J1.96Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.2Hz, Ar-H), 7.39-7.37 (d, 2H, ^3J8.68Hz, Ar-H), 7.35-7.32 (d, 2H, ^3J8.16Hz, Ar-H), 7.23-7.17 (m, 5H, Ar-H), 7.07-7.05 (t, 1H, ^3J8.24Hz, Ar-H), 4.15-4.11 (t, 2H, ^3J6.56Hz, Ar-O-CH_2-), 2.73-2.69 (t, 2H, ^3J7.56Hz, Ar-CH_2-), 1.91-1.84 (quin, 2H, ^3J7.04Hz, Ar-O-CH_2-$C\underline{H_2}$-), 1.68-1.27 (m, 46H, 23 × -CH_2-), 0.90-0.87 (m, 6H, 2 x -CH_3).

1-(3-Fluoro-4-*n*-octadecyloxybenzoyloxy-2-fluoro-4-benzoyloxy)phenylene-3-(4-*n*-dodecylbenzoyloxy-4-benzoate), 7.F.10

Yield, 71%; m.p. 82.0°C; ν_{max}: 3076, 2920, 2849, 1738, 1730, 1614, 1288, 1138, 1070 cm^{-1}; δ_H: 8.29-8.27 (d, 2H, ^3J8.68Hz, Ar-H), 8.21-8.17 (t, 1H, ^3J8.52Hz, Ar-H), 8.13-8.11 (d, 2H, ^3J8.16Hz, Ar-H), 7.97-7.95 (d, 1H, ^3J8.68Hz, Ar-H), 7.90-7.87 (dd, 1H, ^3J11.44Hz, ^4J2.0Hz, Ar-H), 7.52-7.48 (t, 1H, ^3J8.24Hz, Ar-H), 7.39-7.37 (d, 2H, ^3J8.68Hz, Ar-H), 7.35-7.32 (d, 2H, ^3J8.16Hz, Ar-H), 7.23-7.17 (m, 5H, Ar-H), 7.07-7.05 (t, 1H, ^3J8.28Hz, Ar-H), 4.15-4.11 (t, 2H, ^3J6.56Hz, Ar-O-CH_2-), 2.73-2.69 (t, 2H, ^3J7.64Hz, Ar-CH_2-), 1.91-1.84 (quin, 2H, ^3J7.08Hz, Ar-O-CH_2-$C\underline{H_2}$-), 1.66-1.26 (m, 50H, 25 × -CH_2-), 0.90-0.87 (m, 6H, 2 x -CH_3).