行政院國家科學委員會補助專題研究計畫成果報告

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計畫類別：個別型計畫

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本成果報告包括以下應繳交之附件：

□出席國際學術會議心得報告及發表之論文各一份

執行單位：淡江大學 化學系

中　華　民　國　92　年　3　月　15　日

Abstract

Banana mesophases are observed for seven-ring and five-ring bent skeleton molecules. Mesophase temperatures are higher for the homologues of seven-ring systems. The B1 phases are observed for homologues with shorter-chains and B2 phases for the homologues with longer-chains. With the existence of an extra hydrocarbon chain at the central benzene ring of the seven-ring system, a tilted ‘y’ type molecule is obtained, and a peculiar phase of antiferroelectric character is observed aside the B1 and B2 phases. Further studies of X-ray diffraction and electric field effect are needed.

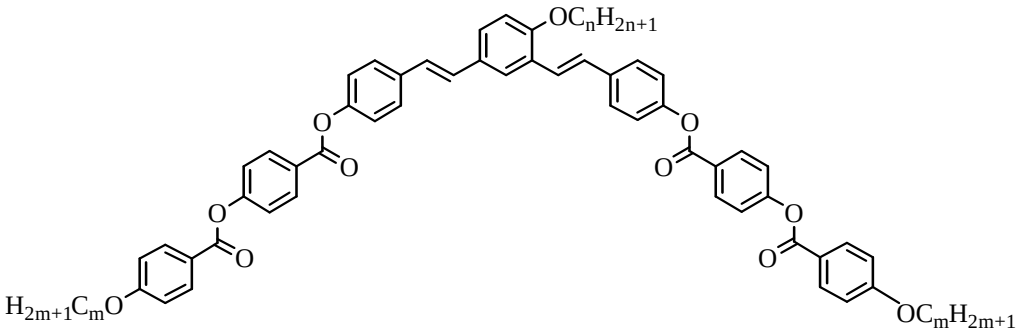
Keywords: Banana phase, banana molecule, liquid crystal, antiferroelectric, X-ray

摘要

含有七個環及五個環的彎曲形液晶分子呈現香蕉型液晶相. 七個環的液晶分子呈現的液晶相溫度較五個環的高. 短碳鏈的分子呈現 B1, 長碳鏈的分子呈現 B2. 七個環的液晶分子的中心環帶有長碳鏈時是‘y’型液晶分子, 它們除了 B1 及 B2 外, 還有一特殊相, 具有反鐵電性. 進一步的證實尚待 X-光繞射及電場效應實驗.

關鍵詞 ： 香蕉型液晶相 彎曲形液晶分子 反鐵電性 X-光繞射

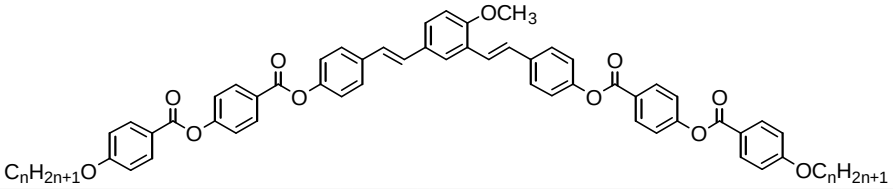
For the banana-shaped mesogens, 2,4-bis(4-substituted stilbenyl)-1-alkyloxy benzene derivatives, the general structures are shown below, we have systematically changed the molecular dimensions in two directions. One is the hydrocarbon chain length of the central benzene ring and the other is the length of the hydrocarbon chains at the ends of the arms of the bent skeleton. For these seven-ring bent mole- cules the mesophases exhibit relatively high temperatures. The phases observed are mainly B1 and B2 phases. However, dependent upon the lengths of the hydrocarbons chains, a peculiar phase occurs. Part of the results is shown in the Table on next page. It is of antiferroelectric-like character. Thorough investigations by the X-ray diffraction and electric field effect are still needed to definitely identify this phase.



n = 1 , 4 , 5 , 6 ,7 , 8 , 12 , 16 , 18

m = 6 , 8 , 9 , 10 , 12 , 14 , 16

Table 1 ：SAn 之顯微鏡升溫相轉移溫度（℃升降溫速率 5℃/min）、**DSC** 升溫相轉移溫度（℃升降溫速率 5℃/min）和轉移焓ΔH（KJ/mole，升降溫速率 5℃/min）：

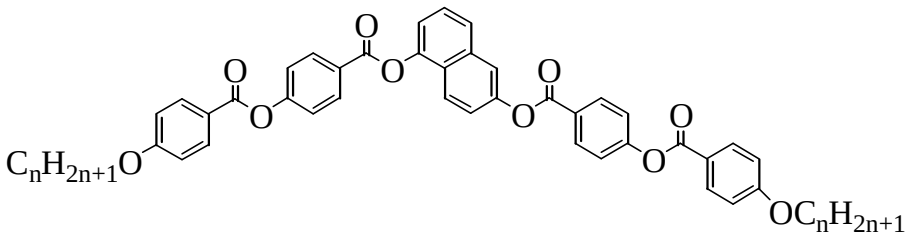


compound	n	K		M_1		B_1		B_2		I
1	6	•	165 [1] 【34.21】[2]	•	244 【15.64】	•		•		•
2	8	•	160 【34.02】	—	233 【16.84】	—		•		•
3	9	•	155 【36.08】	—		•	226 【19.57】	—		•
4	10	•	160 【37.55】	—		•	223 【20.09】	—		•
5	12	•	131 【25.44】	—		•	214 【24.19】	—		•
6	14	•	133 【26.23】	•		—		—	215 【24.40】	•
7	16	•	125.7 【31.46】	•		—		—	217 【28.40】	•

1、顯微鏡升溫相轉移溫度取第一次升溫相轉移溫度

2、【】內表轉移焓ΔH

The mesophase behaviors of homologues In are summarized in Table on next page. Banana-leaf like and grainy textures resemble those of B1 and B2 phases are observed for compounds In (n = 4 to 9) and In (n = 10, 12 and 14), respectively. These banana phases are enantiotropic, except that of derivative I4. The values of enthalpy change for the crystal to mesophase and mesophase to isotropic phase transi- tions are of the same order of magnitude. The typical powder X-ray diffraction patterns obtained with samples packed in capillary are shown in figure of next page. There are two sharp peaks at the small angle region and one broad band at the large angle region for the compound I8. This pattern resembles that of B1 phase reported in the literature and indicates a columnar rectangular phase structure. For the derivative I12, the strong and sharp peak at small angle corresponds to a layer spacing of 3.76 nm, and the tiny peak corresponds to one half of this value. This pattern suggests a layered phase structure. The broad band at large angle region indicates liquid like behaviors within the layer. This result is similar to that of the B2 phase reported. Antiferroelectric switching behaviors are observed for the B2 phases of the present series, further confirms the existence of this B2 phase.



n	Cry		B_1		B_2		Iso	m.p.
4	·	**132.76** *15.26*	·	**(185.56)** *19.21*	–		·	**188.47** *57.49*
6	·	**117.45** *25.71*	·	**168.39** *22.17*	–		·	**159.91** *35.79*
7	·	**108.54** *18.39*	·	**159.79** *20.13*	–		·	**147.72** *29.59*
8	·	**102.06** *20.22*	·	**154.32** *22.17*	–		·	**140.31** *32.11*
9	·	**92.13** *19.36*	·	**146.99** *21.96*	–		·	**135.98** *27.29*
10	·	**94.55** *18.65*	–		·	**141.05** *23.03*	·	**106.78** *20.75*
12	·	**96.44** *21.25*	–		·	**146.03** *25.77*	·	**110.58** *25.19*
14	·	**97.17** *25.28*	–		·	**146.5** *27.34*	·	**110.57** *28.79*

表一：相轉移溫度（℃）和熱焓（KJ mol^{-1}）。Cry = Crystalline phase；B_1= Banana mesophase 1；B_2= Banana mesophase 2；Iso=Isotropic phase。·表示有此液晶相；—則表示無此液晶相；( ) 表示單相。