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# Synthesis, characterization and liquid crystalline properties of a series of hydroxybiphenyl benzoate and biphenyl bis(benzoate)

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## Abstract

Two series of hydroxybiphenyl benzoate **2a-2c** and biphenyl bis(benzoate) **3a-3c** have been synthesized by the esterification reaction of 4-alkoxybenzoic acid **1a-1c** with 1,1'-biphenyl-4,4'-diol in presence of DCC and DMAP in dichloromethane at room temperature under nitrogen atmosphere. Products ratio (**2** vs **3**) were not significantly influenced with the variation of alkoxy substituents. The newly synthesized ester products were characterized by IR and NMR spectroscopy as well as elemental analysis. The transition temperatures and mesophases have been investigated by differential scanning calorimetry and polarized optical microscopy. Although the synthesized ester derivatives, **3a-c** are achiral, molecular chirality is exhibited in their mesophases.

Key words: Biphenyl benzoate; liquid crystals; achiral; chiral

## 1. Introduction

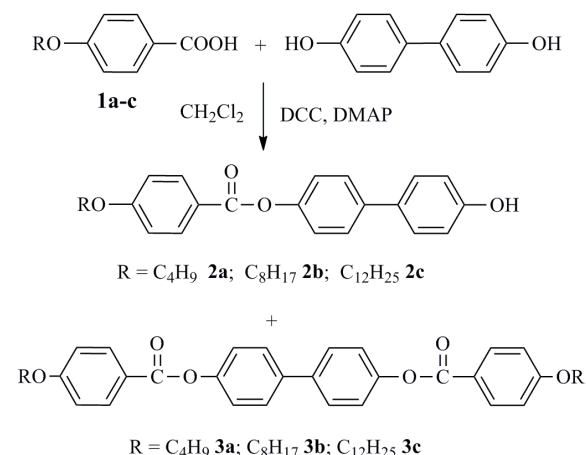
Thermochromism is a well-known and useful property frequently observed in different types of materials [1]. The change of color with temperature is certainly a phenomenon which is of interest in the field of liquid crystals [2], and many applications are based on this property: thermometers (fever indicator and gadgets), colored electro optic films and light-emitting diodes [3]. Phototunability of the cholesteric liquid crystals pitch and the circular polarized reflection wavelength has formed the basis of many applications including tunable color reflectors and filters, sensors, tunable lasers and molecular switches [4-12]. Chirality is a very intriguing issue in liquid crystal (LC) science [13]. There are many types of chiral LCs, such as chiral nematic (N\*) [14], chiral smectic C (SC\*) [15], blue phase [16-17] and twisted grain boundary (TGB) phase [18]. Liquid crystal molecules can be made chiral either by including chirality within the molecules or by adding chiral dopant into liquid crystal phases [13, 19]. In recent years, there have been many reports on the design of liquid crystals exhibiting chiral phases, without possessing any chiral center [20-21]. Among them, bent-core molecules with one or two flexible tails exhibit a wide variety of novel structural phenomena involving the interplay of chiral, polar, and liquid crystalline order [20c-d]. During controlled heating or cooling, these materials form isotropic fluid, though they possess short range positional and orientational order. As a result, the macroscopic symmetry is broken to produce chirality, despite the fact that these molecules are achiral. This type of symmetry breaking is observed in nematic and smectic phases, and polarized optical microscopy gives regions of different optical properties. Rotation of one polarizer from its crossed position clockwise by a certain angle (< 20°) gives two different optical domains, and rotating the polarizer in the opposite direction by the same angle reverses the position of the domains. Although a vast number of achiral bent-core (1-3-substituted phenyl core)

liquid crystals with chiral phases are available in the literature [20c-d, 21], rod-like liquid crystals using biphenyl and phenylpyrimidine linked *via* flexible methylene spacer are also reported [20a-b]. In this study, we report the synthesis and characterization of a new series of hydroxybiphenyl benzoate **2a-2c** and biphenyl bis(benzoate) **3a-3c** and investigation of their liquid crystalline properties. The use of long, linear aromatic biphenyl ring contributes to the thermal stability of the mesophase. Though the newly formed ester derivatives **3a-c** are achiral, the molecular chirality is exhibited in their mesophases without introducing chiral dopants.

## 2. Results and discussion

### 2.1 Syntheses

The ester products of hydroxybiphenyl benzoate **2a**, and biphenyl bis(benzoate) **3a** were synthesized by the



Scheme 1 Synthesis of hydroxybiphenyl alkoxybenzoate and biphenyl bis(alkoxybenzoate) derivatives

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