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## Mesomorphic Properties of 4-(4-Pyridyl)-Benzoic Acid Esters

Ona Adomėnienė<sup>a</sup>, Povilas Adomėnas<sup>a</sup>, Antanas Gleiznys<sup>a</sup>, Lidija Poloudina<sup>a</sup> & Yasuyuki Gotoh<sup>b</sup>

<sup>a</sup> Laboratory of Liquid Crystals, Vilnius University, Naugarduko 24, Vilnius, 2006, LITHUANIA

<sup>b</sup> Chisso Corporation 7-3, Marunouchi 2-Chome, Chiyoda-ku, Tokyo, 100-8333, JAPAN

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## Mesomorphic Properties of 4-(4-Pyridyl)-Benzoic Acid Esters

ONA ADOMĖNIENĖ<sup>a</sup>, POVILAS ADOMĖNAS<sup>a</sup>,  
ANTANAS GLEIZNYS<sup>a</sup>, LIDIJA POLOUDINA<sup>a</sup> and  
YASUYUKI GOTOH<sup>b</sup>

<sup>a</sup>*Laboratory of Liquid Crystals, Vilnius University Naugarduko 24, Vilnius 2006, LITHUANIA* and <sup>b</sup>*Chisso Corporation 7-3, Marunouchi 2-Chome, Chiyoda-ku, Tokyo 100-8333, JAPAN*

Formerly unknown 4-(4-pyridyl)benzoic acid was synthesized and some of its esters were prepared, their mesomorphic properties were examined. Alkyl-esters of the said acid are non-mesomorphic, while three-ring aryl esters form monotropic smectic A state. Esters aren't stable, they hydrolyze easily.

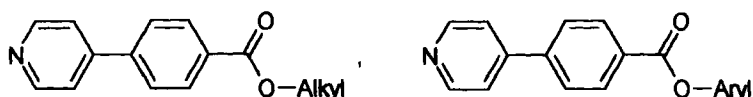
**Keywords:** 4-(4-pyridyl)benzoic acid; mesomorphic

That's well known, that almost all possible simple structure units were examined during last decades for their suitability as building blocks in creating of mesogenic compounds. So it was a surprise for us when we noticed that 4-(4-pyridyl)benzoic acid wasn't ever used for synthesis of possible mesogenic compounds, though evidently an

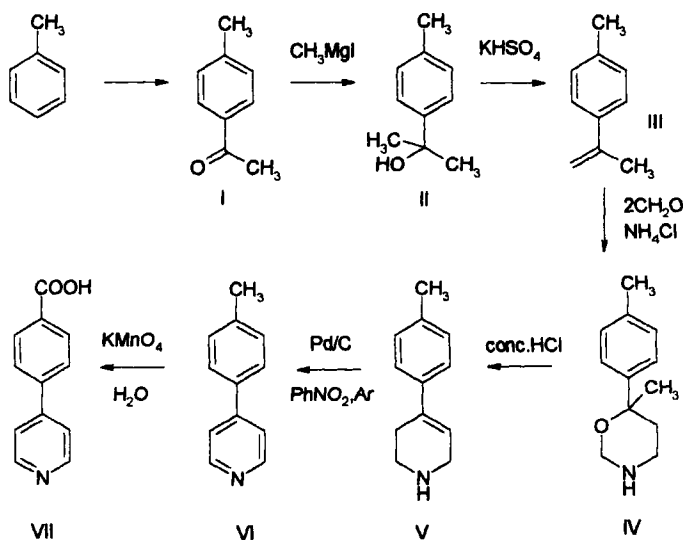
introduction of terminally oriented nitrogen electron pair might lead to compounds possessing interesting material properties. Even more, we couldn't detect any report about synthesis of the a.m.

4-(4-pyridyl)benzoic acid in literature.

In this work, we have prepared some esters of the a.m. acid. Their common structural formulas



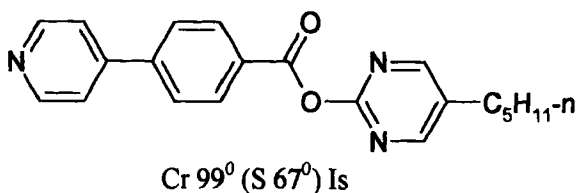
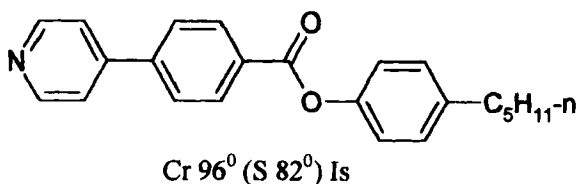
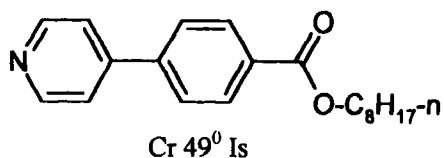
The key intermediate, 4-(4-pyridyl)benzoic acid, was prepared by an oxidation of 4-(4-methylphenyl)pyridine by potassium permanganate. The latter was prepared by the next sequence of transformations:



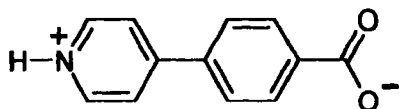
First steps of these transformations are commonly known. A transition from 4, $\alpha$ -dimethylstyrene (III) to 4-(4-methylphenyl) - pyridine (VI) was worked out by M.D. Hartough, C. J. Schmidle and their co-workers in 1952-54 [1-4]. To our experience, that's the simplest and the most reliable route of synthesis of aryl-substituted 4-arylpyridines. An oxidation of (VI) to target 4-(4-pyridyl)-benzoic acid (VII) was smoothly performed by potassium permanganate in water, both pyridine and benzene rings remain unaffected. 4-(4-Pyridyl)-benzoic acid (VII) is a colorless crystalline compound, its m.p. 310<sup>0</sup>C (decomp.) – much higher than that of structurally similar biphenylcarboxylic acid (226<sup>0</sup>C). It may be crystallized from diluted nitric acid.

Esters of 4-(4-pyridyl)-benzoic acid were obtained by a standard reaction of 4-(4-pyridyl)-benzoyl chloride with alcohol either phenol in pyridine solution. It should be noted, that long-chain alkanols (decanol or higher) failed to react at these conditions. Other esterification conditions, such as acid-catalyzed either PEP -induced condensation reaction between free acid and alkanol either phenol, didn't lead to formation of target esters. DCC induced esterification of 4-(4-pyridyl)-benzoic acid by alkanols, but not by phenols. In this case (acid VII, phenol and DCC in chloroform solution) 4-(4-pyridyl)-benzoic anhydride was obtained instead of target esters.

Alkyl 4-(4-pyridyl)benzoates (I) are nonmesomorphic compounds possessing rather low melting points, while three-ring compounds (II) form monotropic smectic mesophases:



Esters of 4-(4-pyridyl)-benzoic acid aren't stable, much less than corresponding esters of carbocyclic aromatic acids. This may be caused by energetic reasons – free 4-(4-pyridyl)-benzoic acid evidently exists in the form of inner salt, which is energetically more favorable, than that in the case of uncharged esters:



**References**

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- [4] C. J. Schmidle, John E. Locke and Richard C. Mansfield. J. Org. Chem. 1954, v. 21, p. 1194.