Polymesomorphism in N-(*p*-*n*-Alkoxybenzylidene)-*p*-*n*-Alkylanilines (*n*O.*m*) Compounds

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The polymesomorphism exhibited by the famous benzylidene aniline homologues, N-(*p*-*n*-alkoxybenzylidene)-*p*-*n*-alkylanilines (*n*O.*m*'s) is presented from the systematic studies carried on these compounds at the centre. The salient features observed are listed. The importance of alkoxy chain length over the alkyl chain in the manifestation of smectic polymorphism in higher homologues of these materials is also discussed.

Key words: *n*O.*m*'s; Smectic Polymorphism; Alkoxy Chain; Phase Variants.

The N-(*p*-*n*-alkoxybenzylidene)-*p*-*n*-alkylanilines, (*n*O.*m*), are well known Schiff base liquid crystals. The synthesis of these compounds, with variation of the alkoxy and alkyl chain numbers, has gained momentum since the synthesis of MBBA (1O.4) a well known room temperature nematogen, in 1969 [1]. Because of the ease in preparation and the convenient working temperature, these materials have become model systems for the study of 1D, 2D, and 3D melting. The earlier studies on the lower homologues with alkoxy and alkyl chain lengths ≤ 7 have shown that these compounds exhibit mainly nematic and orthogonal smectic phases with rare presence of tilted phases such as smectic-C and smectic-G. An exception is 5O.6 [2], which exhibits the phase sequence variant NACBFG.

In the present short communication the alkoxy and alkyl chain numbers *n* and *m* of *n*O.*m* varied from 1 to 18 (except 17) and 1 to 10, 12, 14, and 16, respectively. The salient and interesting features observed are:

1. The phase variants are put in relation to the phase sequence of NACBFG (5O.6), which is the only compound exhibiting this hexa variant.

2. There are 21 different types of phase sequence.

3. These include different types of mono, di, tri, tetra, penta, and hexa variants.

4. There are three types of mono variants (N, A, F), five types of di variants (NA, NG, AB, AF, FG), five types tri variants (NAB, NAG, ABF, ABG, AFG), five types of tetra variants (NACB, NACG, NABG, ACBG, ACFG), two types of penta variants (NACFG, NACBG) and one type of hexa variant (NACBFG), totaling 21 different types of liquid crystalline phases.

5. Five different types of phase sequences are exhibited by single compounds, viz. ABF by 8O.10, NACB by 4O.7, NACBG by 5O.7, NACFG by 5O.5, and NACBFG by 5O.6. The above three compounds differ in one alkyl chain number. Addition and subtraction of one alkyl chain to 5O.6 gives two different types of penta phase variants which differ in B and F smectic. Both are present in 5O.6.

6. The dominant phase sequence variants are ($\geq$ 20 compounds which exhibit the same sequence of phases) N (20), F (19), AB (30), FG (25), NAB (19), and ABG (29).

7. The concentration of the nematic phase is confined around lower members of the alkoxy chain number.

8. The orthogonal smectic-A phase starts with the compound 6O.10, where the quenching of the nematic phase occurs.

9. The nematic phase is present in all compounds with the alkoxy chain number 5, except 2O.16.

10. The 5O.*m* homologues are unique, as all phase variants exhibited by *n*O.*m* compounds happen to be subset variants. This argument further derives support from the largest phase variant, NACBFG (5O.6). This is depicted in the Fig. 1.

11. The dominant single phase variants N and F are concentrated on the top right and down right of Table 1, respectively. The A phase is less prominent.

n/m **1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**12**	**14**	**16**
1			N				N	N	N	N	N	N
2			N			N	N	N	N	N	NA	A
3		N	N	NAG	NAG	N	NA	N	NA	N	N	N
4	NA NG	NG	NABG	NABG	NAB	NACB	NAB	NAB	NAB	NAB	NAB	NAB
5	NG NG	NG	NAG	NACFG	NACBFG	NACBG	NABG	NAB	NAB	NAB	NAB	NA
6	NAB NG	NAG	NABG	NABG	NABG	NAB	NABG	NA	AB	ABG	AB	ABG
7	NAB NAB	NAB	NACG	NACG	ACFG	NACG	ACBG	ABG	AB	AB	ABG	AB
8	NAB NAB	NABG	ABG	ABG	ACBG	ACBG	ABG	ABG	ABF	AB	ABG	AB
9	NAB AB	AB	AFG	ABG	ACFG	ACBG	ACFG	ACBG	ACBG	ABG	ABG	AB
10	NA ABG	AB	ABG	ABG	ACFG	ABG	ACFG	ACBG	ACFG	AFG	FG	AFG
11	A AB	ABG	AB	ABG	AFG	AFG	AFG	ACBG	AFG	FG	FG	FG
12	A AB	AB	ABG	ABG	ABG	AFG	AFG	FG	AFG	FG	FG	FG
13	A AB	AB	ABG	ABG	AB	AB	AF	FG	F	FG	FG	FG
14	A AB	ABG	AB	ABG	ABG	AB	F	F	F	F	FG	FG
15	AB	AB	ABG	ABG	ABG	FG	F	F	F	F	FG	FG
16	AB	AB	AB	F	AF	F	F	FG	F	FG	FG	FG
18	AB	AB	AB	F	F	FG	FG	F	F	F	F	FG

Table 1. Polymesomorphism in *n*O.*m* compounds

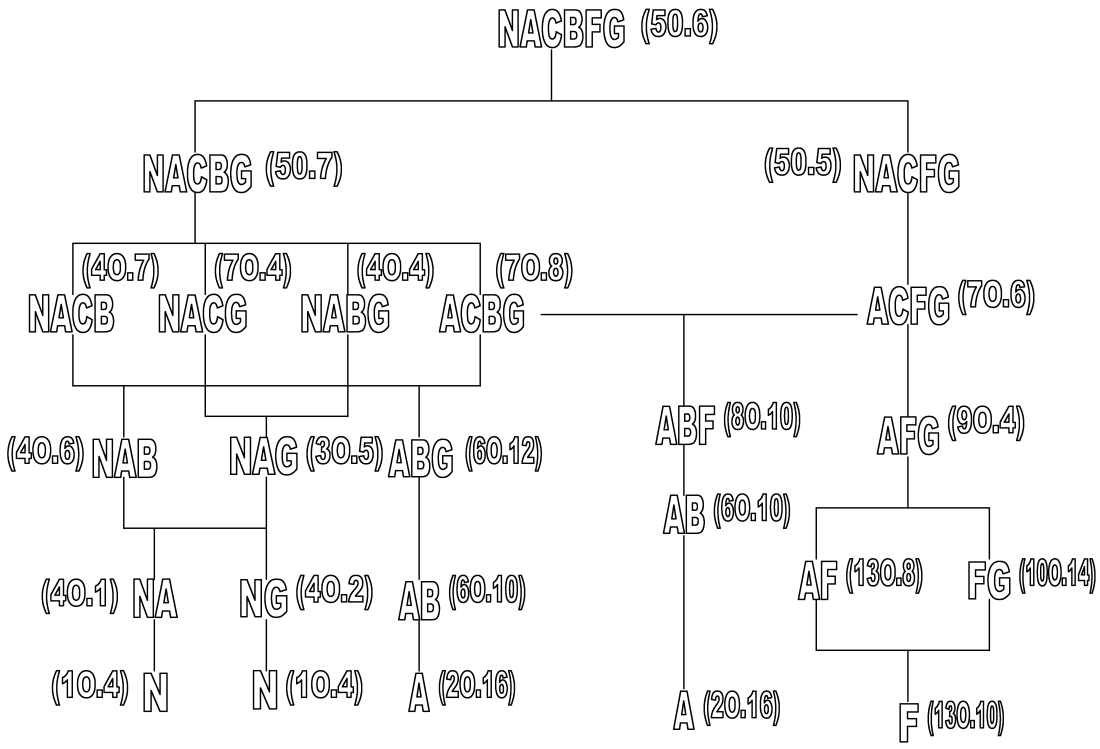

Fig. 1. *n*O.*m* Phase sequence variant tree.

12. The phase variants with the tilted phases C and F are concentrated in the middle of Table 1.

13. The smectic-G phase is distributed throughout.

14. Like the single mono variants N and F, the di phase variants AB and FG are equally populated among the *n*O.*m* compounds.

15. Even though the AB sequence is distributed on the left down and right up positions of the table, the FG is more concentrated on the right down of the Tables [3–8].

16. The orthogonal smectic phases A and B occur more often than the tilted C and F phases.

17. With increase of the alkoxy chain length, the onset of the single phase variant smectic-F with a small alkyl chain length is observed. The minimum n and m numbers required for the manifestation the single

phase variant F are 13 and 10, respectively, while the onset smectic-F from isotropic melted with smectic-G occurred with $n = 10$ and $m = 14$.

18. The number of compounds with smectic polymorphism is larger than that with the nematic phase.

19. The 21 different phase sequence variants and their degeneracy in *n*O.*m* compounds are: N (20), A(5), F (19), NA (7), NG (6), AB (30), AF(2), FG (24), NAB (19), NAG (4), ABG (29), ABF (1), AFG(10), NACB (1), NACG (3), NABG (8), ACBG (8), ACFG (6), NACBG (1), NACFG (1), NACBFG (1).

20. Most of the phase transitions in these compounds are enantiotropic, and the clearing temperature is < 100 °C.

Figure 1 shows the different phase sequence variants of *n*O.*m* compounds and the compounds which exhibit these variants with the minimum alkoxy chain length.

A detailed review on these *n*O.*m* compounds will be published in due course.

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