

Phase Diagrams of Binary Mixtures of the Homologous Series of 4'-n-alkyl-4-cyanobiphenyls

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The homologous series of 4'-n-alkyl-4-cyanobiphenyls (NCB) are very important in modern liquid crystal display technology, but much information about them is not available to the academic community, as much research performed with these molecules was conducted for industrial interests. The aim of this summer research project was to document the phase behavior of binary mixtures of these compounds as well as to better understand the effects of the length of the tail group on the liquid crystalline phases of these molecules.

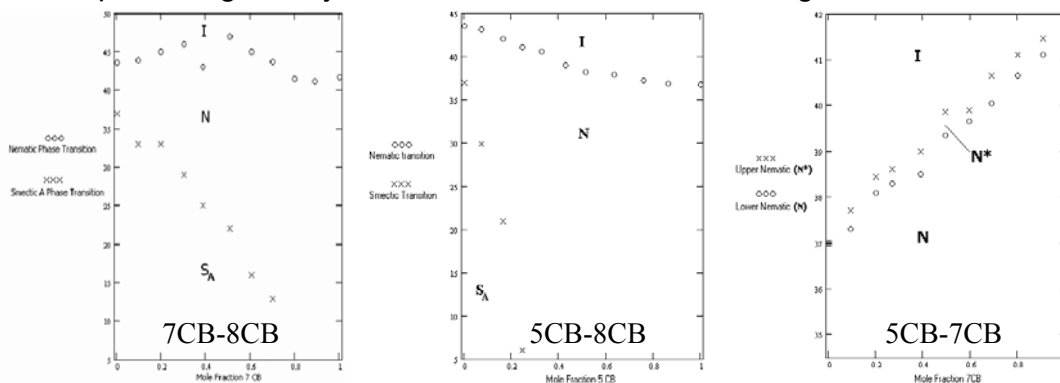
The 5CB-7CB, 5CB-8CB, and 7CB-8CB binary mixtures were studied using polarized light microscopy as well as differential scanning calorimetry. Phase diagrams were constructed using both heating and cooling studies. The microscopy studies show intriguing results, prompting interest in further study of this series.

Of particular interest in the studies carried out this summer was that of the 7CB and 8CB mixture. By making binary mixtures of these two compounds, it was shown that the transition temperature between the nematic and isotropic phases can be elevated above the isotropic to nematic transition temperature of either pure material, a phenomenon alien to phase diagrams of any kind. This was an intriguing result because it allows an extension of the temperature range over which the nematic phase exists while suppressing the smectic A phase.

This extension of the nematic phase occurs when mixing the homolog that precurses the first smectogen in the series (7CB) with a smectogenic homolog (8CB). It would be interesting to continue studying 7CB binary mixtures with higher order smectic homologues in the series in order to see if there is a trend in the extension of the nematic phase region beyond the first smectogenic homolog.



Photo microscopy pictures of a nematic liquid crystalline phase (top) displaying a schlieren texture, and the smectic A liquid crystalline phase (bottom) displaying both a focal conic texture, with a small patch of fan texture in its midst. These pictures were taken using the 7CB-8CB system at 0.6 mole fraction 7CB.



These phase diagrams were constructed using cooling study data over a temperature range of -15 °C to 60 °C.