Journal of Thermal Analysis, Vol. 53 (1998) 333-335

*Short communication*

# INVESTIGATION OF THE COMPATIBILITY OF A MULTI-COMPONENT TN LIQUID CRYSTAL MIXTURE AND A MULTI-COMPONENT CHOLESTERIC LIQUID CRYSTAL MIXTURE BY DSC

*Li Zhibin, An Zongwei and Hu Rongzu**

Xian Modern Chemistry Research Institute, Xian 710065, Shaanxi, China

## Abstract

The phase transition curves of a multi-component TN liquid crystal mixture (TN 88–1) and a multi-component cholesteric liquid crystal mixture (Ch 88-2) were plotted by using a differential scanning calorimeter. The phase transition temperature and phase transition heat were obtained from the DSC curves. The results show that the components of TN 88–1 are compatible and they can form a stable mixture with CB 15 chiral liquid crystal. The components of Ch 88 –2 are not compatible and Poly (MMA–BMA) can greatly improve their compatibility.

**Keywords:** compatibility, DSC, liquid crystal

## Introduction

Multi-component liquid crystal mixtures are generally needed to obtain a nematic phase with a wide temperature range. However, the components of the mixture must have good compatibility, otherwise the mixture will lose its mesomorphic property after a long period of storage because of phase separation. DSC offers a convenient way to study the compatibility of a multi-component liquid crystal mixture, and we use it to investigate the compatibility of a multi-

* Author to whom all correspondence should be addressed.

*1418–2874/98/ $ 5.00*


*Akadémiai Kiadó, Budapest*
*Kluwer Academic Publishers, Dordrecht*

component TN liquid crystal mixture (TN 88–1) and a multi-component cholesteric liquid crystal mixture (Ch 88–2).

## Experimental

A Perkin-Elmer DSC–2C differential scanning calorimeter was used to analyze the liquid crystals. The heating rate was controlled at 5 K $min^{-1}$ and the scanning temperature range was from 250 to 360 K. A 8~10 mg sample was weighed and three replicates of each sample were tested.

TN 88–1 contains five TN liquid crystals: 4-ethyl-4′-cyanobiphenyl, 4′-cyanobiphenyl trans-ethylcyclohexanecarboxylate, 4′-pentylphenyl-4-methylbenzoate, 4′-pentylphenyl-4-propylbenzoate and 4′-pentylphenyl-4-pentylbenzoate. Ch 88–2 contains three cholesteric liquid crystals: cholesteryl nonylate, cholesteryl chloride and cholesteryl oleic carbonate. CB 15, (+)-4-(2-methylbutyl)-4′-cyanobiphenyl, is a chiral liquid crystal. Poly (MMA-BMA) is a copolymer of methyl methylacrylate and butyl methylacrylate (1:1). All compounds were prepared by our Institute and have a purity better than 99.5%.

## Results and discussion

The phase transition curves of TN 88–1 and Ch 88–2 are shown in Figs 1 and 2, and the phase transition temperature ($T$) and phase transition heat ($\Delta H$) are listed in Tables 1 and 2.

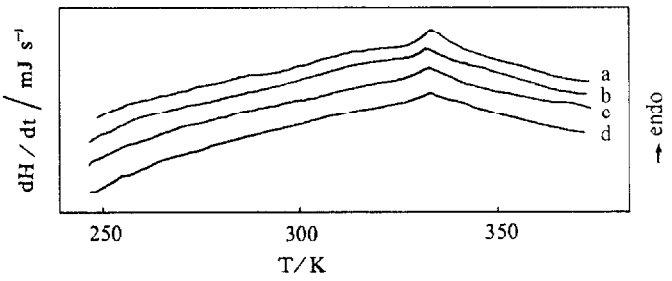


**Fig. 1** DSC curves of the phase transition of TN 88–1 and 99.91% TN 88–1 + 0.09% CB 15 after storing a) TN 88–1, 3 days; b) TN 88–1, 30 days; c) 99.91% TN 88–1 + 0.09% CB 15, 3 days; d) 99.91% TN 88–1 + 0.09% CB 15, 30 days

From Fig. 1 and Table 1, we known that each curve has only one endothermic phase transition peak and has the same phase transition temperature and phase transition heat. It indicates that the five components of TN 88–1 are compatible and can form a stable mixture with CB 15.

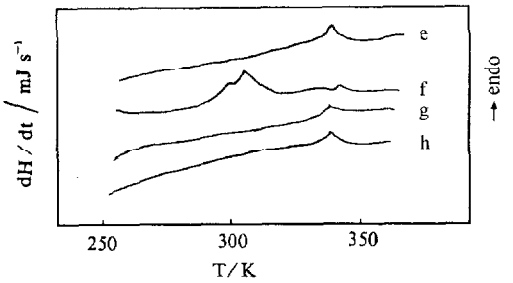


**Fig. 2** DSC curves of the phase transition of Ch 88 –2 and 40% Ch 88 –2 + 60% Poly (MMA –BMA) after storing e) Ch 88 –2, 3 days; f) Ch 88 –2, 30 days; g) 40% Ch 88 –2 + 60% Poly (MMA–BMA), 3 days; h) 40% Ch 88 –2 +60% Poly (MMA-BMA), 30 days

**Table 1** Phase transition temperature and phase transition heat of TN 88 –1

| Sample | Storing time/day | $T$(K)/$\Delta H$(J g$^{-1}$) |
|---|---|---|
| TN 88–1 | 3 | 331.1/8.01 |
| TN 88–1 | 30 | 330.9/7.93 |
| 99.91% TN 88–1+0.09% CB 15 | 3 | 330.5/7.85 |
| 99.91% TN 88–1+0.09% CB 15 | 30 | 330.6/7.91 |

**Table 2** Phase transition temperature and phase transition heat of Ch 88 –2

| Sample | Storing time/day | $T$(K)/$\Delta H$(J g$^{-1}$) | | |
|---|---|---|---|---|
| | | $T_1$ | $T_2$ | $T_3$ |
| Ch 88–2 | 3 | – | – | 341.1/1.48 |
| Ch 88–2 | 30 | 304.2/1.26 | 332.9/1.74 | 348.0/0.25 |
| 40% Ch 88–2+ 60% Poly (MMA–BMA) | 3 | – | – | 341.7/1.26 |
| 40% Ch 88–2+ 60% Poly (MMA–BMA) | 30 | – | – | 341.6/1.27 |

From Fig. 2 and Table 2, we can see that curve f has three endothermic phase transition peaks, which indicates that Ch 88–2 is unstable during storing. Curve g and h have only one endothermic phase transition peak and have the same phase transition temperature and phase transition heat, which indicates that poly (MMA–BMA) can greatly improve the compatibility of the components of Ch 88–2.