

# THE BINARY PHASE DIAGRAMS FOR THE SYSTEMS CYCLOTRIMETHYLENE TRINITROSAMINE-N,N'-DIMETHYL- N,N'-DIPHENYL UREA AND 2,4,6-TRINITROTOLUENE-PICRIC ACID

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**ABSTRACT** The phase diagrams of cyclotrimethylene trinitrosamine (TMNT)-N, N'-dimethyl-N, N'-diphenyl urea (C<sub>2</sub>) and 2,4,6-trinitrotoluene (TNT)-picric acid (PA) have been constructed by differential scanning calorimetry (DSC). Their eutectic points are 86.3 and 61.5°C respectively. The compositions corresponding to the eutectic points are 57.0 weight percent TMNT and 68.4 weight percent TNT respectively.

**KEY WORDS** binary phase diagram, cyclotrimethylene trinitrosamine (TMNT), N, N'-dimethyl-N, N'-diphenyl urea (C<sub>2</sub>), 2,4,6-trinitrotoluene (TNT), picric acid (PA).

## INTRODUCTION

Cyclotrimethylene trinitrosamine (TMNT), 2,4,6-trinitrotoluene (TNT) and picric acid (PA) are three widely used energetic materials. N, N'-dimethyl-N, N'-diphenyl urea (C<sub>2</sub>) is one of ingredients of propellants. The phase diagrams for TMNT-C<sub>2</sub> and TNT-PA have never been reported so far. The aim of this paper is to study their binary phase diagrams. From the point of view of casting process of composite explosive, these phase diagrams are of great importance.

## 1 EXPERIMENTS

### 1.1 Materials

TMNT, TNT and PA used in this work were prepared in our institute.

Their purities were more than 99.5%. Above mentioned materials were purified by recrystallization before used. Mixed samples were prepared by mixing various amounts of TMNT and C<sub>2</sub> or TNT and PA.

### 1.2 Experimental equipment and conditions

The measurements of the phase diagram for the binary systems TMNT-C<sub>2</sub> and TNT-PA were carried out on Shanghai Balance Manufactures' CDR-1 differential scanning calorimeter. The experimental conditions were as follows: DSC sensitivity  $\pm 20.92\text{mJ/s}$ , sample mass of mixture 10mg, heating rate  $2^\circ\text{C/min}$ , paper speed 20mm/min, atmosphere static air, reference material  $\alpha\text{-Al}_2\text{O}_3$ . The error in reading of temperature is less than  $0.25^\circ\text{C}$ .

## 2 RESULTS AND DISCUSSION

Table 1 lists the melting points for binary systems TMNT-C<sub>2</sub> and TNT-PA. The phase diagrams obtained by data in Table 1 show in Fig. 1 and Fig. 2.

Table 1 The melting points for TMNT-C<sub>2</sub> and TNT-PA systems

TMNT-C <sub>2</sub>		TNT-PA	
TMNT (wt%)	Melting point (°C)	TNT (wt%)	Melting point (°C)
0.00	122	0.00	122
5.00	119	5.00	118
9.90	117	11.0	114
15.0	113	17.5	110
20.1	110	24.0	106
24.0	106	29.0	102
30.0	104	34.0	98.0
36.0	100	40.0	93.8
40.0	98.0	44.2	89.3
45.0	94.0	50.1	84.0
50.0	92.0	55.0	79.5
53.0	89.0	58.0	76.0
55.8	87.5	59.5	73.8
57.0	86.3	63.0	68.3
57.7	87.5	66.0	63.5
60.4	88.0	68.4	61.5
66.0	89.0	70.0	63.0
70.0	89.3	72.0	65.0
76.0	90.0	74.0	66.3
80.0	90.5	76.0	68.0
84.0	91.5	80.0	70.5
90.1	93.3	82.0	72.3
94.0	96.0	84.6	74.0
96.0	98.0	90.0	76.3
98.0	102	96.0	78.0
100	105	100	80.5

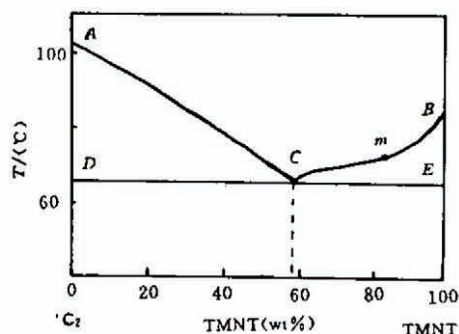


Fig. 1 Phase diagram for binary system TMNT-C<sub>2</sub>

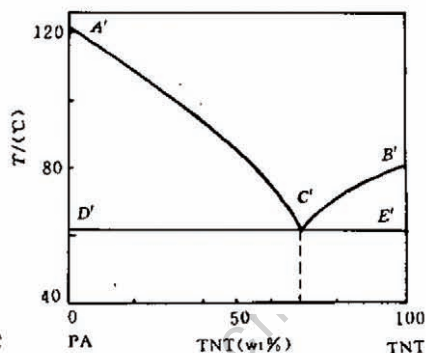


Fig. 2 Phase diagram for binary system TNT-PA

The curve  $AC$  in Fig. 1 gives the melting points of  $C_2$  when in contact with TMNT. The curve  $CB$  gives the melting points of TMNT when in contact with  $C_2$ . The curves  $AD$ ,  $DE$  and  $EB$  are solid curves for the system TMNT- $C_2$ . The points  $A$  and  $B$  in Fig. 1 are the melting points of TMNT and  $C_2$  respectively. The point  $C$  of  $86.3^\circ\text{C}$  without change in composition is the eutectic point for the TMNT- $C_2$  system at atmosphere pressure. The composition corresponding to point  $C$  is  $57.0 \pm 0.5$  weight percent TMNT. The transition point  $m$  in curve  $CB$  is attributed to the transition of crystalline of TMNT.

In Fig. 2 are given the liquid and solid curves for TNT-PA system. The points  $A'$  and  $B'$  are the melting point of PA and TNT respectively. The point  $C'$  of  $61.5^\circ\text{C}$  is the eutectic point for the system TNT-PA. It corresponds to  $68.4$  weight percent TNT.

## 环三次甲基三亚硝胺-N,N'-二甲基-N,N'-二苯基脲和 2,4,6-三硝基甲苯-苦味酸的二元相图

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**摘要** 用差示扫描量热法绘制了环三次甲基三亚硝胺(TMNT)-N,N'-二甲基-N,N'-二苯基脲( $C_2$ )和2,4,6-三硝基甲苯(TNT)-苦味酸(PA)的二元相图。它们的低共熔点分别是 $86.3^\circ\text{C}$ 和 $61.5^\circ\text{C}$ 。相对于低共熔点的组成分别为 $57.0$ 重量百分数 TMNT 和 $68.4$ 重量百分数 TNT。

**关键词** 二元相图 环三次甲基三亚硝胺 N,N'-二甲基-N,N'-二苯基脲 2,4,6-三硝基甲苯 苦味酸