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Melania Bosco Masera<sup>a</sup>

<sup>a</sup> Dipartimento di Fisica, Politecnico di Torino, Torino, Italy

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# THE EUTECTIC OF HgTI AMALGAM (40 ± 0.1)% At. TI IS AT THE TEMPERATURE OF 1°C

MELANIA BOSCO MASERA

*Dipartimento di Fisica, Politecnico di Torino, Corso Duca degli  
Abruzzi 24, 10129, Torino, Italy*

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By means of a toroidal oscillating viscometer logarithmic decrements of dampings have been measured in the presence or absence of HgTI amalgam at 40.1 atomic percent of thallium at different temperatures, ranging from +0.125°C to +15.500°C, with fluctuations every 0.25°C. Measurements were performed in two different periods (1: 29/01/1992 – 14/04/1992 and 2: 18/04/1992 – 24/09/1992). In both periods, the eutectic was found at 1.125°C. When comparing 40.1% at. TI, 40% at. TI and 39.9% at. TI amalgams, values of the eutectic are perfectly coincident. The logarithmic decrement of the 40.1% at. TI is located, in the phase diagram, on the left side with respect to the 40% at. TI.

*Keywords:* Phase diagram; viscometer damping

## INTRODUCTION

In previous papers (1,2) HgTI amalgams at 40% at. TI and 39.9% at. TI raised some interest about their melting process.

In the present paper we focused on the logarithmic decrements of a viscometer damping, in the presence or absence of the 40.1% at. TI amalgam at different temperatures from +0.125°C to +15.500°C. Measurements were performed in two different periods: the first from 29/01/1992 to 14/04/1992, the later from 18/04/1992 to 24/09/1992.

## EXPERIMENTAL APPARATUS

The toroidal oscillating viscometer used in the present investigation was the same as employed in References 1, 2 and 3.

## EXPERIMENTAL RESULTS

The viscometer dampings in the presence or absence ( $\delta$  and  $\delta_0$ , respectively) of HgTl amalgam at 40.1% at. Tl have been measured at different temperatures, ranging from  $+0.125-1^\circ\text{C}$  to  $+15.500^\circ\text{C}$ , with fluctuations every  $0.25^\circ\text{C}$  and in two different periods (1: 29/01/1992 – 14/04/1992 and 2: 18/04/1992 – 24/09/1992).

Experimental results are plotted in Figures 1 and 2.

Figures 3 and 4 show mean values of logarithmic decrements recorded for HgTl 40.1% at. Tl in the first period (29/01/1992 – 14/04/1992) and in the latter period (18/04/1992 – 24/09/1992), respectively (1).

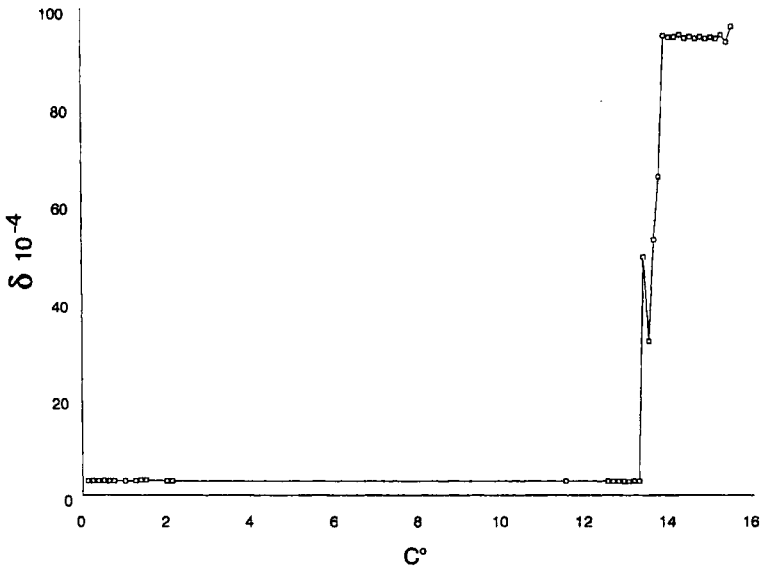


FIGURE 1 Logarithmic decrements of dampings of the viscometer containing the HgTl amalgam at 40.1% at. Tl versus temperature ( $+0.125^\circ\text{C}$  to  $+15.500^\circ\text{C}$ ) in period 1 (29/01/1992 – 14/04/1992).

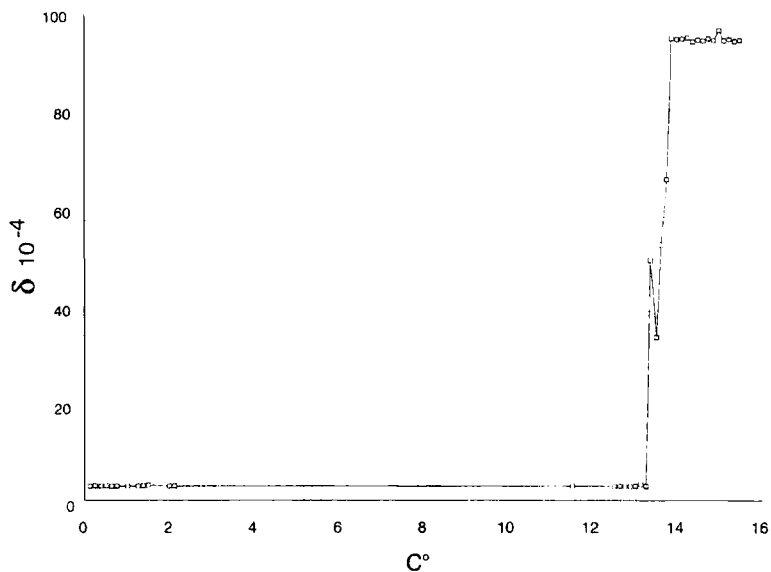


FIGURE 2 Logarithmic decrements of dampings of the viscometer containing the HgTl amalgam at 40.1% at. Tl versus temperature ( $+0.125^\circ\text{C}$  to  $+15.500^\circ\text{C}$ ) in period 2 (18/04/1992 – 24/09/1992).

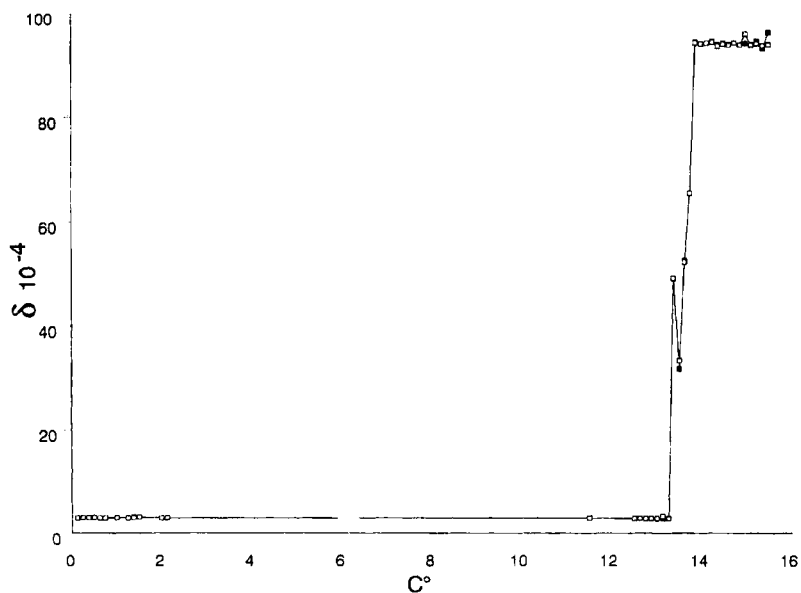


FIGURE 3 Mean values of logarithmic decrements of dampings of viscometer containing the HgTl 40.1% at. Tl versus temperature ( $+0.125^\circ\text{C}$  to  $+15.500^\circ\text{C}$ ) recorded from 29/01/1992 to 24/09/1992.

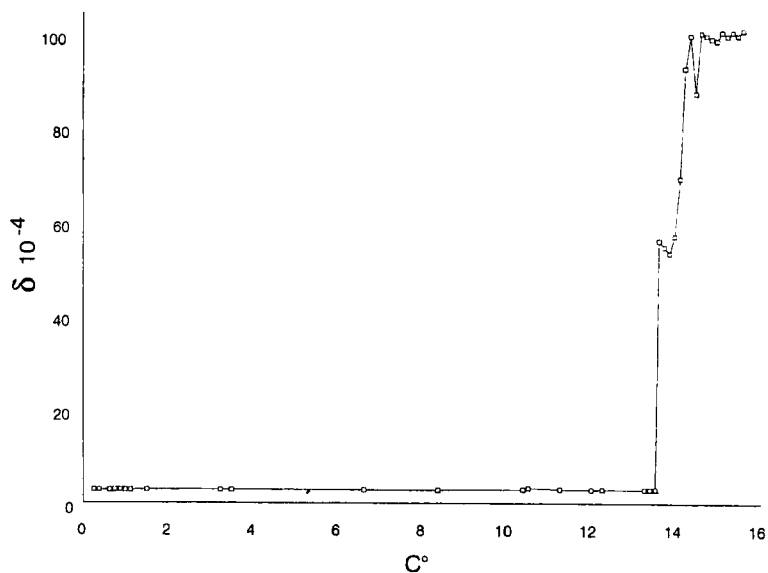


FIGURE 4 Mean values of logarithmic decrements of dampings of viscometer containing the HgTl 40% at. Tl versus temperature ( $-2^{\circ}\text{C}$  to  $+15.625^{\circ}\text{C}$ ) recorded from 31/07/1990 to 09/05/1991.

Figure 5 shows mean values of logarithmic decrements recorded for HgTl 39.9% at. Tl versus temperature (from  $-1^{\circ}\text{C}$  to  $+15.625^{\circ}\text{C}$ ) recorded from 05/04/1991 to 24/12/1991 (2).

Figure 6 shows the comparison between mean values of logarithmic decrements of dampings calculated for HgTl amalgam at 40% at. Tl (closed squares) and at 39.9% at. Tl (open spares).

Figure 7 shows the comparison between Figures 3 and 6.

## DISCUSSION OF EXPERIMENTAL RESULTS

The melting process of the HgTl amalgam at 40.1% at. Tl occurs gradually, as shown by temperature-dependent variations represented in Figures 1 and 2. At the temperature of  $+1.125^{\circ}\text{C}$  we obtained  $\delta_1 = 2.9336150 \cdot 10^{-4}$ ,  $\delta_{01} = 2.461650 \cdot 10^{-4}$  (Fig. 1) and  $\delta_2 = 2.9291190 \cdot 10^{-4}$ ,  $\delta_{02} = \delta_{01} = 2.461650 \cdot 10^{-4}$  (Fig. 2). We may conclude

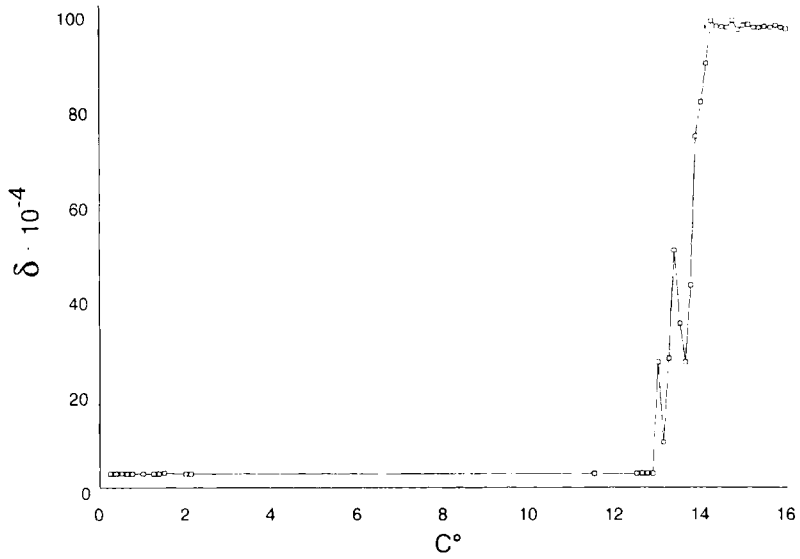


FIGURE 5 Mean values of logarithmic decrements recorded for HgTl 39.9% at. Tl versus temperature (from 1°C to +15.625°C) recorded from 05/04/1991 to 24/12/1991.

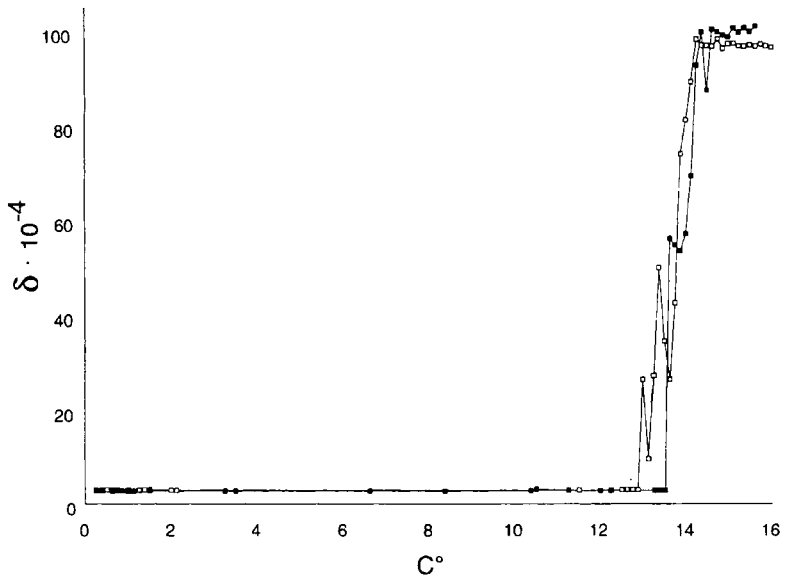


FIGURE 6 Comparison between mean values of logarithmic decrements of dampings calculated for HgTl amalgam at 40% at. Tl (closed squares) and at 39.9% at. Tl (open squares) (2).

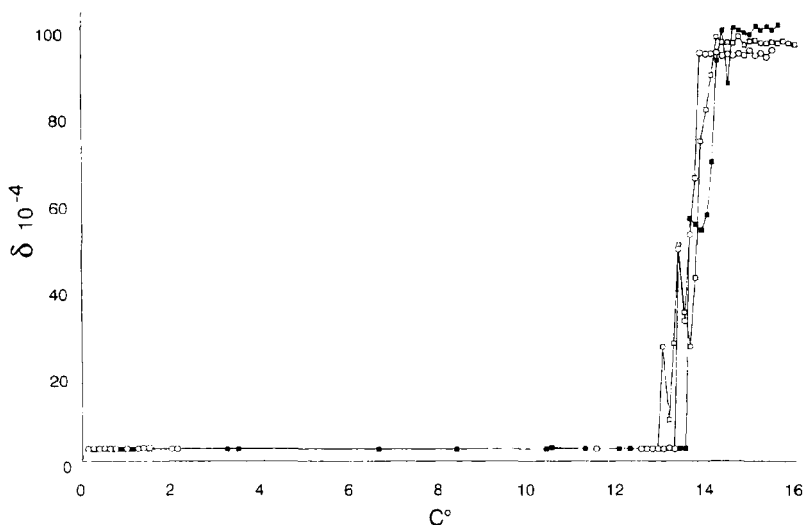


FIGURE 7 Comparison between Figures 3 and 6.

that at this temperature the amalgam is completely solid and this is the eutectic temperature. The value of the eutectic is perfectly coincident in the two periods.

These results are in accord with theoretical values ( $T^*$ ;  $\delta^*$ ) obtained from Ref. 1

$$\delta_1^* = 2.6336150 \cdot 10^{-4} \quad \Delta\delta_1 = 0.3 \cdot 10^{-4}$$

$$\delta_2^* = 2.6291190 \cdot 10^{-4} \quad \Delta\delta_2 = 0.3 \cdot 10^{-4}$$

With regard to the HgTl amalgam at 40.1% at. Tl, we found the eutectic at  $+1.25^\circ\text{C}$ . When increasing the temperature from  $+13^\circ\text{C}$  to  $+15.500^\circ\text{C}$ , the logarithmic decrement is substantially identical in the two groups of experiments, and the liquid state is coincident.

Mean values of logarithmic decrements calculated for HgTl 40.1% at. Tl (Fig. 3) are coincident with those calculated for HgTl 40% at. Tl (Fig. 4), as well as for HgTl 39.9% at. Tl (Fig. 5). We may conclude that at  $+1.125^\circ\text{C}$  the amalgam is completely solid and this is the eutectic temperature. The value of the eutectic is perfectly coincident for  $(40 \pm 0.1)\%$  at. Tl.

When increasing the temperature from  $+13^{\circ}\text{C}$  to  $+15.500^{\circ}\text{C}$ , the logarithmic decrement relevant to the two averages is substantially identical, but is reached in a different way. At the temperature of  $+13.750^{\circ}\text{C}$ ,  $\delta_1 = 42.555672 \cdot 10^{-4}$  for 39.9% at. Tl,  $\delta_2 = 54.811685 \cdot 10^{-4}$  for 40% at. Tl and  $\delta_3 = 65.566187 \cdot 10^{-4}$  for 40.1% at. Tl, being  $\delta_1 < \delta_2 < \delta_3$ . When increasing the temperature, such a relationship is no more apparent.

Further experiments will be performed to investigate the behavior of additional atomic percentages of HgTl amalgam at temperatures higher than  $+13.750^{\circ}\text{C}$ .

## SUMMARY

The logarithmic decrement of the dampings of an oscillating viscometer in the presence or absence ( $\delta$  and  $\delta_0$ , respectively) of the HgTl amalgam at 40.1% at. Tl has been investigated at different temperatures, ranging from  $+0.125^{\circ}\text{C}$  to  $+15.500^{\circ}\text{C}$  and in two different periods (29/01/1992–14/04/1992 and 18/04/1992–24/09/1992). We found that the HgTl amalgam at 40.1% at. Tl is completely solid at the temperature of  $+1.125^{\circ}\text{C}$  in the two different periods. The liquid state was coincident as well. When comparing 39.9% at. Tl, 40% at. Tl and 40.1% at. Tl amalgams, values of the eutectic are perfectly coincident. We may conclude that the amalgam is completely solid and this is the eutectic temperature. The value of the eutectic is perfectly coincident for  $(40 \pm 0.1)\%$  at. Tl.

## References

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