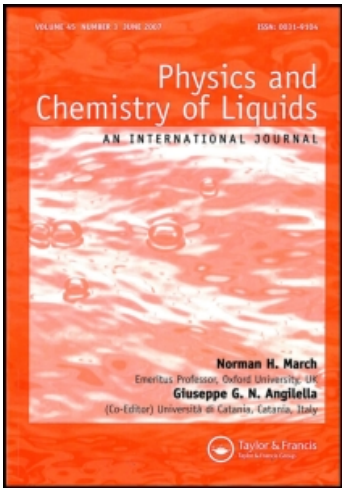

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ANOMALIES IN Hg–Tl AMALGAM VISCOSITY

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1 INTRODUCTION

Some anomalies have been found in the Hg–Tl amalgam viscosity variation with temperature and component concentrations. An intermetallic compound formation or a miscibility gap in the amalgam state diagram are probably responsible for the anomalous behaviour. Viscosity measurements have been carried out through the toroidal oscillating viscosimeter described in Ref. 1, while previous results on Hg-Tl viscosity are reported in Refs. 2,3,4. At the present time, the anomalies were mainly observed at 28.2% at. Tl, which belongs to a composition interval where the amalgam behaviour is particularly complex; two intermetallic compounds are located at 28.57% and at 33.33% at. Tl while their maxima in the state diagram are so flat to be hardly detectable. Anomalous results were obtained well above the solidification temperature and, though they are not evidence for a phase transition to an inhomogeneous liquid state or to an intermetallic compound, such a transition is a likely cause of the anomalous behaviour.

2 DESCRIPTION

The viscosity measurements performed with oscillating viscosimeters relay on the measurement of the free oscillation damping of a crucible, which is a function of the viscosity of the liquid contained in the crucible (see Ref. 1). The oscillation transient of the crucible is recorded by plotting the oscillation amplitude as a function of time and smooth and nearly exponential transient records, as the one in Figure 1a, are

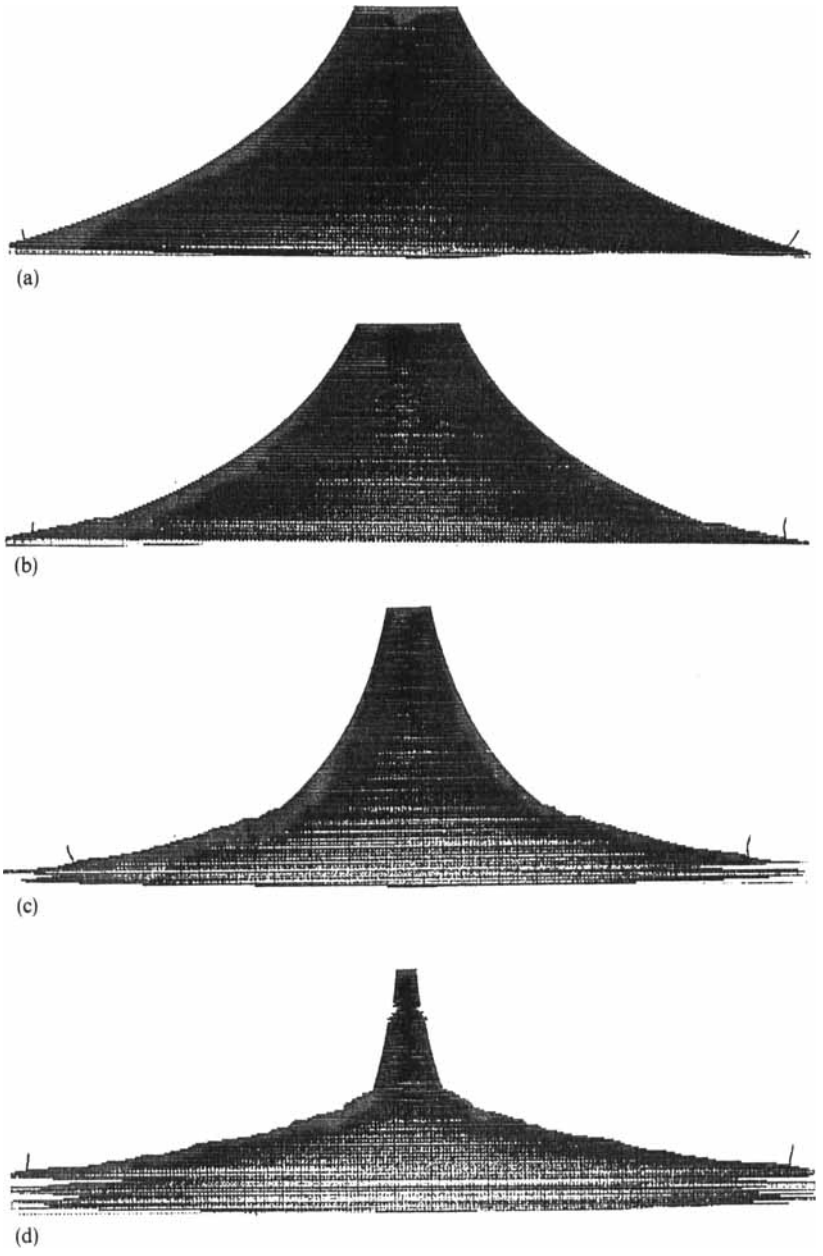

Figure 1 Oscillation decay records of a toroidal viscosimeter filled with Hg–Tl amalgam at 28.1% at Tl; (a) 16.5°C, (b) 16.375°C, (c) 15.375°C, (d) 15.25°C.

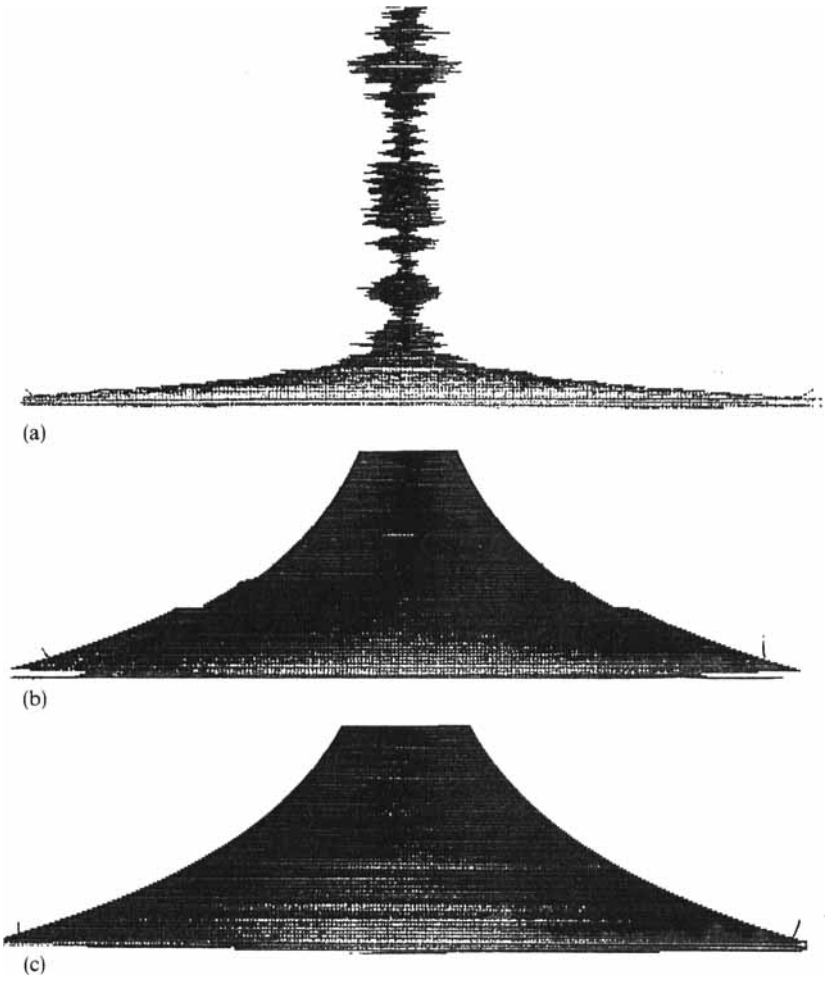

Figure 2 Oscillation decay records for Hg–Tl amalgam at 28.1% Tl; (a) 13.5°C, (b) 13°C, (c) 12.5°C In (c) the liquid is again homogeneous.

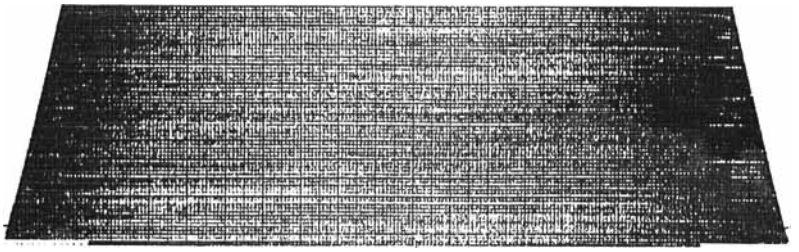

Figure 3 Oscillation decay record for 28.1% at Tl Hg–Tl amalgam at 0.5°C; solid phase.

obtained. The exponential decay of these records can be described by a single damping constant. Departure from the nearly exponential oscillation decay are consequence of inhomogeneity in the oscillating crucible liquid, whose viscosity cannot be defined any longer.

In the measurements at 28.2% at. Tl, the oscillation decay records starts to show evident irregularities from temperatures lower than 16.375°C (0.125°C is the temperature resolution of the measurements). Figure 1b,c,d and Figure 2a,b show some of the records obtained in the temperature range [16.375°C, 13°C]; the random irregularities grow up as the temperature is decreased below 16.375°C, reach a maximum and decrease again, eventually disappearing as the temperature approaches 13°C. According to Figure 2c, a homogeneous liquid phase reappears for temperatures lower than 12.5°C. Complete solidification occurs at temperatures around 0°C; the oscillation decay record of Figure 3, obtained at 0.5°C, shows the nearly undamped oscillations typical of a solid phase.

The anomalous behaviour of the oscillation decay records as a function of the temperature might be consequence of an intermetallic compound formation or of a phase reappearance phenomenon[5]. In the latter case, the two amalgam components may be in an immiscible phase in the temperature range where the oscillation amplitude shows random fluctuations and in a homogeneous mixed phase for temperatures outside such an interval. Hg–Tl amalgam at the lower Tl concentration of 28.1% at. is presently under investigation and its oscillation decay records have already shown behaviour similar to the one at 28.2% at. Further experiments to ascertain the cause of the oscillation transient anomalies are in project.

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