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Dielectric and Thermodynamic Study of Camphor and Borneol Enantiomers and their Binary Systems

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Highlights

- DSC and dielectric results are presented for binary systems of camphor and borneol.
- The results show the formation of the continuous solid solution.
- α-, α_D-, and β- process are found for all the systems.
- The sub - T_g process is Johari–Goldstein type and is dominating one.

Abstract

Phase behavior and dielectric relaxation of camphor and borneol enantiomers in neat phase and their binary mixtures have been studied employing dielectric spectroscopy (20 Hz – 2 MHz), differential scanning calorimetry (DSC), and X-ray diffraction techniques. Camphor and borneol form a solid solution in phase SI which is an orientationally disordered phase of fcc structure and gets supercooled during cooling. For solid solutions, two α- processes and a sub-Tg process are observed. The fm values of primary relaxation processes are deviating from Arrhenius behavior. The activation energy of sub-Tg process lies in the range of 11– 18 kJ/mol and is of Johari-Goldstein type indicating the intermolecular nature. Sub- Tg process is perhaps the dominant process seen at higher temperatures studied by Smyth et al. (1963) and Davies et al. (1962).

Keywords: Glass transition, Dielectric relaxation, Differential Scanning Calorimetry (DSC), d-Camphor, l- Camphor, d- Borneol, l- Borneol.

1. Introduction

Camphor and Borneol are well-known bicyclic monoterpenes. These compounds form the main constituents of many essential oil preparations and have been used in traditional medicine since centuries, and more recently in food processing, fragrances and pharmaceutical [1-9]. Two optically active forms of camphor are dextrorotatory camphor ((1R,4R)-(+)/d- camphor) and laevorotatory camphor ((1S,4S)-(-)/l- camphor), and of borneol are (+)/d- borneol and (-)/l- borneol (structural formulae are shown in Fig. 1) and