

Multifrequency Ultrasonic Correlation System for Measuring Sound Velocity and Sound Velocity Change

Kazuhiko Imano, Daitaro Okuyama and Noriyoshi Chubachi¹

Department of Electronic Engineering, Mining College,
Akita University, Tegata Gakuen-mati, Akita 010 Japan

¹Department of Electrical Engineering, Tohoku University,
Aramaki Aoba-ku, Sendai, 980 Japan

(Received March 15, 1990; accepted April 23, 1990)

Key words: ultrasonic spectroscopy, sound velocity, correlation, frequency multiplication method

To extract the information of sound velocity of materials, cross correlation between reference signal and acoustic signal has been taken electrically. Three different types of multifrequency ultrasonic correlation systems for measuring sound velocity and sound velocity changes are described. The experiments with water as a standard liquid sample in the frequency range 2 ~ 17 MHz established the measurement accuracy at better than 0.03 percent for velocity and 15 ppm for velocity change. Experiments in the application of the system have been performed with electrolyte of MnSO_4 , liquid crystal MBBA and several kinds of solid samples to demonstrate the effectiveness of the system. As a result, the velocity dispersion in aqueous solution of MnSO_4 by relaxation, as well as the phase transition of nearly the second order in MBBA, is clearly detected. Moreover, the measured velocities of the solid samples are in good agreement with those obtained by the PEO method; a measurement accuracy of within 0.1 percent is attained.

1. Introduction

Ultrasonic spectroscopy has been interpreted as a tool for revealing the frequency dependence of sound velocity and absorption, and as an indispensable means of studying the physical properties of materials, such as the absorption