Acta Cryst. (1981). A37, 272

Phonon scattering in condensed matter. Edited by H. J. MARIS. Pp. xix + 481. New York, London: Plenum, 1980. Price US $52.50.

This book is the proceedings of the third International Conference on Phonon Scattering in Condensed Matter. The conference was held in August 1979, at Brown University, Providence, Rhode Island. This series of conferences was held in Paris and Ste Maxime in 1972, in Nottingham in 1975, and then the present conference at Brown University. The conference was organized by Professor H. J. Maris and his colleagues together with an international advisory committee.

More than one hundred participants from 18 countries gathered at the conference, and presented ten invited papers and 95 contributed papers during the four days. The conference consisted of eleven sessions and, in the order that appears in this book, they are: Amorphous materials, Spin–phonon interactions, Phonon–phonon interactions, Helium, Kapitza resistance, Defects, Phase transitions, New techniques, Phonon propagation and echoes, Semiconductors, metals and superconductors. In addition, discussion meetings on Kapitza resistance and on amorphous materials were held.

To give a rough idea about the scope and interests of the conference, the following are the titles and authors of the invited papers: Phonon scattering in metallic glasses, J. L. Black (Brookhaven National Lab.); Echo phenomena in disordered solids, B. Golding & J. E. Graebner (Bell Labs.); Kapitza resistance studies using phonon pulse reflection, H. Kinder, J. Weber & W. Dietsche (Tech. Univ. München); Characteristics of Kapitza conductance, A. F. G. Wyatt (Univ. Exeter); Phonons and phase transitions in quasi-one-dimensional conductors, T. Ishiguro (Electrotechnical Lab.); Stimulated phonon emission, W. Grill (Tech. Hochschule Darmstadt); Phonon detection by the fountain pressure in superfluid ^{4}He films, W. Eisenmenger (Univ. Stuttgart); Ultrasonic spectroscopy of the acceptor ground state in cubic semiconductors, K. Lassman & H. Zeile (Univ. Stuttgart); Images of electron-hole droplets and ballistic phonons in Ge, J. P. Wolfe, M. Greenstein, G. A. Northrup & M. Tamor (Univ. Illinois); Phonon optics, carrier relaxation and recombination in semiconductors; case of GaAs epitaxial layers, V. Narayanamurti (Bell Labs.).

Roughly speaking, there appear to have been two streams of research in this field. One is the study where monochromatic, *i.e.* mono-frequency, sound waves are generated in materials, and sound attenuation and velocity provide much information on the materials. The other is the study of thermal properties of materials such as specific heat, thermal conductivity and thermal boundary resistance, where the heat and temperature are the quantities to be measured. For the former, measurements using monochromatic sound waves are possible, but the usual upper limit in frequency was in the range 10^9–10^{10} Hz. For the latter, measured results are averages over all phonons in the material although the frequency can go up to 10^{13} Hz. However, in the last ten years or so, the heat pulse technique together with the superconducting tunnel junction, spin–phonon spectrometer and, in addition, direct phonon generation by infrared laser have become useful to obtain monochromatic or quasi-monochromatic phonons with frequencies as high as 10^{13} Hz for studying properties of materials.

One of the major topics of this conference was the Kapitza resistance problem. Kapitza resistance is the thermal boundary resistance between two different materials, especially between liquid helium and some solid. To elucidate the mechanisms giving the boundary resistance, recent experiments make quantitative measurements of monochromatic phonon reflection and transmission at the boundary that is in contact with helium. This is a sort of surface physics problem, and differently prepared surfaces give results with different physical meanings. The effects due to surface conditions, acoustic frequency, acoustic power and so on are discussed in fifteen papers including two invited papers.

Another topic of main interest at this conference was the acoustic properties of amorphous materials. Seventeen papers on this subject were presented. Discussions presented so far are essentially based on the two-level-system model. The model has given phenomenological interpretations rather successfully to experimental observations. Although the mechanism giving the two levels is not yet known, various studies on the effects of neutron irradiation, the specific heat, the power dependence, *etc.* were presented at the conference and are included in this book.

On helium, the second-sound mode to which rotons contribute, phonon–^{3}He coupling in ^{3}He–^{4}He mixtures related to the problem of cooling mixtures to ultralow temperatures, and dislocation dynamics in solid helium are also reported.

In the area of new techniques, papers concerning generation and detection of very high frequency sounds, either monochromatic or quasi-monochromatic, were presented. In addition, the invited paper by Grill seems to indicate an important direction in which to proceed in the future. In this paper, two trials were reported including the experiment to get stimulated phonon emission from V-doped Al_2O_3 in the THz range. This sort of study is surely a fundamental step toward making phonon lasers.

In addition, the effects of various kinds of defects such as impurity, vacancy and dislocation on thermal conductivity are reported. Also, problems related to phonon propagation and echoes, the study of mainly dynamic electronic processes in semiconductors, electronic structure of metals studied by sound, and the effect of sound on superconductors, and phonon emission from superconductors are reported in this book.

This book is recommended to researchers who are interested in fundamental materials physics, especially in the dynamic aspects of materials. This book provides very up to date information in the fundamental acoustic physics of materials.

The next conference of this series will be held in 1982 or 1983 in Stuttgart, Germany.

A. IKUSHIMA

Institute for Solid State Physics
The University of Tokyo
Roppongi
Minato-ku
Tokyo 106
Japan