Recent Developments in Phonon Physics: Overview and Future Outlook

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Over forty years of inelastic neutron scattering have yielded phonon dispersion relations for many crystals. Nevertheless, the accuracy with which the frequencies are known is often insufficient for many research purposes. Eigenvectors remain unknown for most crystals: lattice dynamical models fitting measured frequencies do not yield reliable eigenvectors since the correspondence of eigenvalues to eigenvectors is not unique. *Ab initio* calculations give frequencies and eigenvectors, but their reliability must be contrasted with experiments. Recent Raman scattering of X-rays, obtained from highly monochromatized synchrotron radiation, are yielding important data not attainable by inelastic neutron scattering.

Ultrashort laser pulses are being used for the study of phonons in the time domain (coherent phonons). Combination of pulsed lasers and synchrotron X-rays have recently allowed the investigation of coherent acoustic phonons and the corresponding time resolved X-ray diffraction. *Ab initio* calculations yield information on anharmonic parameters to all orders and about the dependence of harmonic as well as anharmonic parameters on strain. They can be contrasted with recent experiments involving scattering by crystals with variable isotope compositions. Information about isotope-disorder-induced self-energies has been obtained and theoretically interpreted. Isotopic modification can also be used to obtain information on eigenvectors. These experiments also yield information about electron-phonon interactions, both in semiconductors and in high-T_c superconductors. This work and novel information reported at the conference will be discussed and future trends predicted.