II-03

Phonon spectroscopy using nuclear resonant scattering at synchrotron radiation sources

W. Sturhahn, E. E. Alp, T. S. Toellner, R. Röhlsberger, and K. W. Quast
Advanced Photon Source, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439

Measurements of the phonon density of states by inelastic nuclear resonant scattering of synchrotron radiation will be presented for a number of compounds. This new technique takes advantage of a continuously tunable, high-energy-resolution monochromator that permits excitation of nuclei via selective phonon creation and annihilation processes. This technique allows direct determination of phonon density of states for small samples (<5 mg) with an excellent signal-to-noise ratio (S/N≈ 103) in a very short time (several minutes at third-generation synchrotron radiation sources like ESRF, APS, and SPring-8). The energy resolution is variable and can be reduced to about 1 meV using crystal optics or even to μeV levels via nuclear resonant filtering of the incident synchrotron radiation. Thus, for example, soft phonons in reduced dimensionality systems can be studied, as shown in the case of the layered system $SrFeO_{2.5}$, and also disordered alloys can be investigated, as shown in the case of stainless steel.

This work is supported by US-DOE, BES Materials Science, under contract No. W-31-109-ENG-38.