[MS20-02] High pressure studies of lattice dynamics and magnetism by nuclear resonance scattering.

I.Sergeev,

DESY, Hamburg, Germany
E-mail: ilya.sergeev@desy.de

Nuclear resonance scattering rapidly developed with the advent of third generation synchrotron radiation to a method covering a field of hyperfine and phonon spectroscopy. High pressure applications are one of the domains where the technique is extremely powerful. The electronic, magnetic and vibrational properties of the solid states at high pressures can be studied by the nuclear forward and inelastic scattering. Here, several examples of such studies will be presented.The partial Fe, Eu, and Sb phonon densities of states were investigated in the iron based superconductors *L*FeAsO (L=La,Nd,Sm) [1] and $EuFe_2As_2$ The general scaling on Fe-As distance is found for most of the phonon modes from comparison of the rare-earth substitution and application of high-pressure. On the other hand, the pressure-induced structural phase transition in $EuFe_2As_2$ leads to the change of the phonon structure which is not described by this scaling. The anomaly can be related to the electron-phonon coupling.The strong temperature-induced phonon softening with Grüneisen parameter ~12 is found for the small gapsemiconductor $FeSb_2$[2]. On the other hand, the phonon hardening with application of the high pressure is typical for the solid state with Grüneisen parameter ~2. Thus, the observed phonon softening has pure temperature origin and can be related to the metallization occurred in $FeSb_2$.The magnetic and elastic properties of the nickel metal under applied pressure have been studied using nuclear forward scattering with ^{61}Ni nuclear resonance [3]. The magnetic hyperfine splitting at the Ni site was observed up to 260 GPa, which confirms that nickel stays ferromagnetic up to this pressure. The Debye energy, obtained from the measured Lamb-Mössbauer factor, increases by almost a factor of 2 between ambient pressure and 100 GPa. The dependence of the Debye energy over volume contraction is well described by the Grüneisen parameter 2.1.

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