Abstract

"Nuclear inelastic scattering to study the lattice dynamics in iron, iron-invar-systems and tin monoxide under high pressure "

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The nuclear inelastic scattering (NIS) of synchrotron radiation (SR) in this thesis provides the phonon density-of-states (DOS) in Fe (i), the partial DOS of Fe in $Fe_{65}Ni_{35}$ and $Fe_{72}Pt_{28}$ (ii), and Sn in SnO (iii). The Mössbauer-resonances of ^{57}Fe and ^{119}Sn were used.

(i) The NIS experiments of Fe were carried out up to 153 GPa and direction dependent studies up to 130 GPa. Texturing of ε-Fe above 13 GPa develops by uniaxially compression. The direction dependent measurements reveal different DOS-spectra as seen parallel or perpendicular to the high pressure cell axis in the ε-phase. The developed subtraction method allows the calculation of the projected DOS which permits a mode selective analysis. Calculated sound velocities show higher values along the c-axis than in the a,b-plane of ε-Fe.

(ii) NIS-measurements were also carried out in the invar-alloys $Fe_{65}Ni_{35}$ (*p,T*-dependent) and $Fe_{72}Pt_{28}$ (*T*-dependent). The anomal properties of the invar-alloys exhibit also in the DOS spectra and the derived Debye-temperatures. This can be explained by the magnetic properties of Fe.

(iii) SnO shows already at ambient pressure strong texture. This is used for the direction dependent investigation of the DOS like in ε-Fe. NIS-measurements were carried out up to 6.1 GPa. The strong differences between the measurements along the two directions disappear with increasing pressure. This can be explained by the behavior of the layered structure of SnO under pressure. Additional investigations of the pressure dependent kinetic of the disproportionation of SnO to Sn and SnO_2 were done. This study shows that the mechanism of the reaction is strongly influenced by the applied pressure, while the reaction rate strongly depends on the physical state of the occurring Sn.